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FIRST AERO WEEKLY IN THE WORLD

APR - 7 1937

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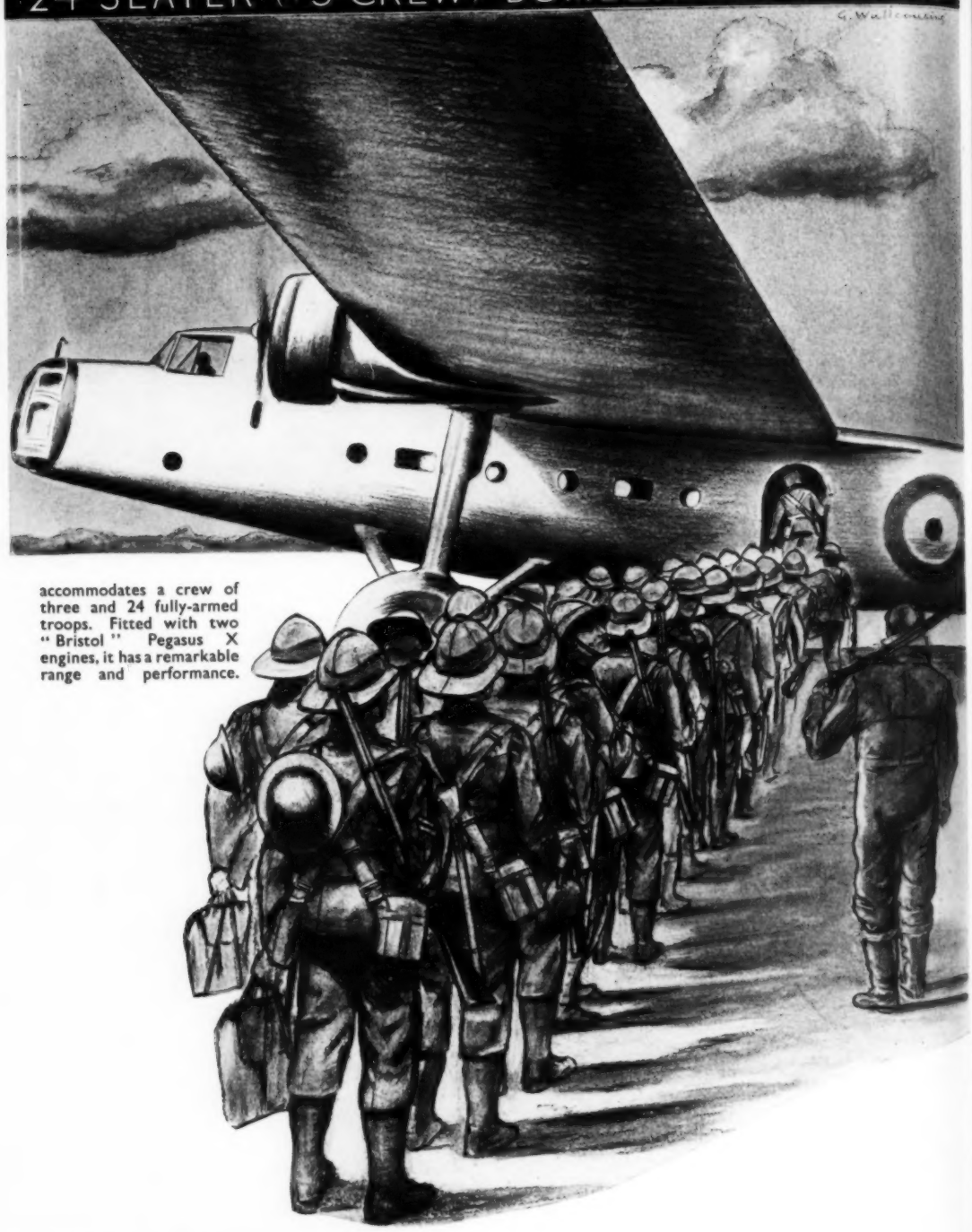

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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Much Cackle : Few 'Osses

IN the polished speech with which Sir Philip Sassoon introduced the Air Estimates in the House of Commons last week, and in the debate which followed that speech. there was a great deal of speechifying and very little matter of importance. The Under-Secretary for Air could tell the House very little about the expansion scheme because nearly all the salient facts had already been made public. Sir Philip is not to be blamed for that. A rather long debate followed, in which no real opposition was raised to the Estimates, but many members made speeches apparently because they liked the sound of their own voices. Interesting points were raised, however, by Mr. O. E. Simmonds and Mr. Lees-Smith.

Mr Simmonds told a story of the negotiations between the Air Ministry and civil flying schools for the training of pilots for the new R.A.F. Volunteer Reserve. He alleged that the Ministry had changed its mind three times in the proposals which it laid before the firms, with consequent delay in getting the scheme under way. Sir Thomas Inskip was put up by the Government to answer the points raised in the debate, and all that he was able to say in answer to Mr. Simmonds was that delays often take place when very great care is being taken to prevent the making of improper contracts which are likely to give excessive profits to the parties with whom they are made. That generalisation was, of course, no answer at all, but one cannot help sympathising with Sir Thomas Inskip on the difficult position in which he has been placed. He cannot possibly know all the details about all the three fighting Services, and he covered himself by admitting that some of Mr. Simmonds' points were bound to be outside his knowledge. The Government ought to provide a more satisfactory answer to such queries, if, indeed, any satisfactory answer can be given.

Mr. Lees-Smith dealt with matters of more fundamental importance. He raised the question of whether air defence is likely to function against air attack. Of course, no definite answer could be given to such a query, but it is noteworthy that recently there has been a tendency on the part of students of the subject to give more credit to the chances of air defence than was the fashion a few years ago. The most notable utterance of this kind was Sir Samuel Hoare's claim that the battleship fleet and naval bases could be made most unattractive targets for enemy bombers to attack. Mr. Lees-Smith also asked whether full use was being made of scientific research in the preparation of air defence, and on this point Sir Thomas Inskip was able to give a completely reassuring answer. Probably other nations are as far advanced as we are in taking advantage of science's help in this matter; but the most important point for British subjects to keep in mind is this—that if air defence can, on the whole, master air attack, the British Isles and the British Empire will be the chief gainers from such a development.

Divided Defence

Mr. Lees-Smith then turned to a subject of first-rate importance, namely, the division of responsibility for air defence between the Air Ministry and the War Office. He quoted *Flight's* assertions that this division had led to bad results, and himself asserted that until a year ago it did lead to bad results. He might well have gone on to dilate on the far worse effects which may come from such divided control in time of war. Sir Thomas Inskip very definitely defended this indefensible system. It is worth quoting his words: "I should have thought that gunnery from the earth was an Army or War Office question, and that therefore, if you handed over gunnery from the earth to the Air Ministry in the expectation of having unity of control, you would immediately produce duality of control in another direction." Why? Oh, Sir Thomas! Why is it duality of control when one party owns some guns and another party owns other guns? Does not the Admiralty own some guns (not firing from the earth, of course, but still guns) while the War Office owns others? Is that duality of control? And if both

those two Ministries may own guns, why should not the Air Ministry also own the guns which must play a part in its special function of air defence? Besides the guns there are also searchlights, which at night time are even more vital to air defence than the guns, and the searchlights also belong to the War Office. Would it be duality of control for the Air Ministry to own the searchlights which must work, so to speak, hand in glove with the night-fighting aircraft, merely because both War Office and Admiralty also own some searchlights? This official argument is utterly feeble, and the position which it is meant to defend is one which may produce disaster in time of war.

Feebler and Feebler

On the following day Mr. Duff Cooper, the War Minister, took up the argument when introducing the Army Estimates, and tried to make out a better case than Sir Thomas Inskip had been able to do. As a form of logic the line which the War Minister took could hardly have been more feeble. Some rather muddled thinkers had suggested that air raid precautions should also be placed under the charge of the Air Ministry and Mr. Duff Cooper fell upon that suggestion and slaughtered it. But this easy score left Mr. Lees-Smith's main position undisturbed, that position being that all the elements of air defence, namely, aircraft, guns and searchlights, ought to be under the control of the Air Ministry. Mr. Cooper's words were: "It is very easy to say, why not let all people engaged on the same business be under the same control? That is only one way of putting the question. Surely, an equally convincing way is that all people in the same profession should be controlled by the same authority." The latter way of putting it does not in the least convince us that in time of war the division of authority for air defence would not be dangerous in the extreme.

Then Mr. Duff Cooper, growing feebler and feebler in his argument, asked if those who supported unified control in air defence would also suggest that the regular anti-aircraft units should also be handed over to the Air Ministry. No such suggestion has ever been made and no sane thinker would ever make such a suggestion. The anti-aircraft units of the regular Army have to do the work of the Army, and if the Army goes overseas they will go with it. They are not in any way concerned with the air defence of Great Britain. To draw such a red herring across the trail takes us nowhere and proves nothing. It shows a weak position when a Minister puts up a man of straw in order to knock him down. The case for unified control of air defence is still unanswered.

SPRING—AT 9,000 ft: A sunny impression, by *Flight's* photographer, of the first of British Airways' new Lockheed Electras flying above the clouds near Southampton, where the machines are being erected. Mr. Marshall Headle, Lockheed's chief test pilot, is in charge.

The Outlook

A Running Commentary on Air Topics

Curiosities—I

THE debate on the Civil Aviation Vote in the House of Commons Committee brought to light some curious facts. Mr. Lindsay Everard, urging that clubs should be subsidised on the number of hours flown rather than upon licences gained, stated that for every thousand hours flown a club pays £250 direct in petrol tax. In his own club at Leicester the subsidy received in five years amounted to £2,570; in petrol tax they had paid £1,150.

Another very interesting fact was disclosed by Mr. Perkins, who stated that at this moment in Canada unsubsidised air lines are carrying more freight on a ton-mile basis than the total freight covered by all the other air lines in the world put together. He naturally concluded that the Canadian market for aircraft was worth capturing, and he deplored the fact that the American manufacturers seemed to have annexed it. The remedy he proposed was also curious, namely, that the Air Ministry should convert the first six Blenheims of which they took delivery into commercial machines and send them to Canada.

Curiosities—II

THE very curious fact, already well known to readers of *Flight*, that booking agencies are not allowed to sell seats on British Airways machines to Scandinavia, though they are allowed to sell seats on foreign lines which fly there, was brought into prominence by two members. Sir Philip Sassoon repudiated responsibility and said it was a matter for the railway companies. He wished Mr. Perkins luck in his announced efforts to get this altered. But the railways can only be taking this course because of their interest in Railway Air Services, and in that case surely the Air Ministry could exert some pressure. There are two Government directors on the board of Imperial Airways, and Imperial Airways hold one-fifth of the shares in Railway Air Services.

Mr. Perkins also believed that the Air Council were largely responsible for certain shortcomings in British air transport, because, he said, they sat in the Air Ministry and did not go out on to the airways of the world. Of course, he did not realise that the Air Council consists chiefly of R.A.F. officers and deals with Service matters, while the responsibility for air transport lies on the Director-General of Civil Aviation. The curious thing was that Sir Philip Sassoon did not correct him.

The Gat Out of the Bag

AMID the apparent indifference of many of the Powers that Be to the question of armament revision, *Flight*, together with certain authorities who could foresee the dangers attendant upon prolonged retention of obsolescent equipment by the R.A.F., has made repeated pleas for the development of aircraft guns.

Sir Philip Sassoon's disclosure (page 305) of the adoption of a new type of Vickers gun and of the American Browning brings with it a measure of satisfaction, although the value of the new weapons must, through the insistence of the Air Ministry that no data be published, remain unassessed.

So long ago as July 11, 1935, *Flight* was able to reveal that a number of Brownings had been purchased by the Ministry, and since that date various Service aircraft have appeared in public "toting" these well-known Colt products. We have, incidentally, published a photograph showing a Browning at an R.A.F. station, but were forbidden to point out that the gun *was* a Browning.

So far as can be gathered, the R.A.F. Browning is essentially similar to the guns used by the American Government for some years and to those specified for machines exported to a number of countries. Of the new Vickers nothing can be said.

Although we are forbidden to discuss the features of the new weapons, we are at least thankful that *something* has at last been done.

Future Possibilities

BY a curious coincidence two men famous in aviation have been looking ahead and have tried to foresee the developments likely to take place in aviation during the next few years. Mr. A. H. R. Fedden, the designer of the famous Bristol engines, recently gave his views to the Royal Aeronautical Society, as was duly reported in *Flight*. His main concern was air-cooled engines. A few weeks before, Mr. Theodore Wright, of the Curtiss-Wright Corporation of America, had covered a rather wide field in an address to the Aeronautic Meeting of the American Association for the Advancement of Science. The report of Mr. Wright's address did not reach this country until it was published in the January issue of the *Journal of the Aeronautical Sciences*, which is the American counterpart of our R.Ae.S. *Journal*.

A Tribute

MR. WRIGHT examines the subject very thoroughly, uses existing knowledge and makes certain assumptions based on legitimate expectations of progress in the immediate future. In his estimate he does not take into account any revolutionary discoveries that may be made. He takes as his starting point Professor B. Melvill Jones's famous 1929 lecture on The Streamline Aeroplane, and incidentally pays a warm tribute to the British research worker. On this basis Mr. Wright arrives at the following probable percentage gains in speed, taking the Douglas D.C.2 as the standard of modern comfortable air transport.

From elimination of wasted drag Mr. Wright expects a gain in speed of 10 per cent. He thinks this will come about by further improvements in streamlining, in shape of windscreens, in surface smoothness and in reduction of interference by better fillets.

By the elimination of unnecessary parasite drag he expects a gain of 4 per cent., and from reduction in induced drag by higher aspect ratios and elliptical wing shapes another 2 per cent. A more perfect taper, thinner wings by greater structural efficiency, and improved wing sections, are expected to net another 2 per cent., as are also improvements in airscrew efficiency. Reduction in weight through the use of better materials may give us another 3 per cent., and a higher wing loading through improved flaps and better wing sections may add about 5 per cent.

It is, however, from flying high that Mr. Wright expects the greatest gain. By flying at 35,000 feet and providing what he calls "cabin pressurisation," Mr. Wright expects a gain in speed of 21 per cent. net. At greater heights the problems, he thinks, become too difficult. All these improvements reach the impressive sum of 49 per cent. increase in present speeds.

Mr. Wright comes to the conclusion that certainly twelve-hour transcontinental (i.e., trans-American) and eighteen-hour transatlantic passenger crossings are not far off.

DIARY OF FORTHCOMING EVENTS—PAGE 302

GUIDONI

Italy's Remarkable Air Research Establish

Visited : A 67 m.p.h. Seaplane Tank

the 1,428 m.p.h. Supersonic Wind Tunn

Unique Fuel Control System in E

Experimental Department

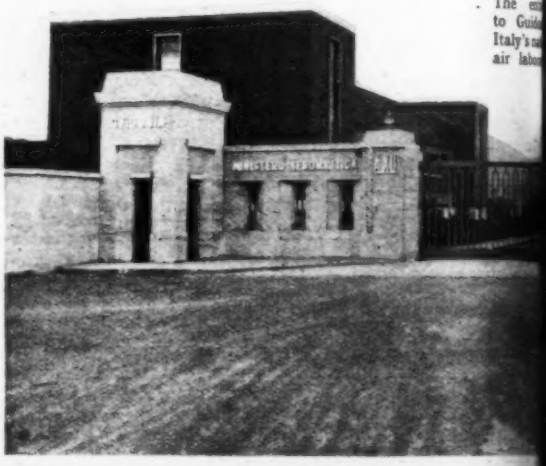
WHATEVER his views may be upon the advantages or otherwise of Fascism, the visitor to Rome cannot fail to be impressed by the work that has been accomplished under the direction of *Il Duce* Mussolini.

I had not visited Rome for many years, and I was certainly filled with admiration for the improvements that had been wrought—the magnificent Via dell'Impero that runs from the Piazza Venezia to the Colosseum; the new University; the Air Ministry—to mention but a few of the things I saw. The Roman people looked happy. I wish I could see the same expression on the faces of the London crowds. And upon the Roman streets I saw occasionally Askari troops walking with Italian troops, fraternising in the ancient city as comrades in arms.

Living was cheap—both for the visitor and, I believe, the Italian people. An excellent room and full meals in a first-class hotel—the Roman equivalent of the Ritz or Piccadilly—cost less than a pound a day. Women's shoes (this is for the women readers of *Flight*) were displayed in the shops at an average price of 10s. to 12s. a pair. One could not buy their equivalent in London for double the price. Invariably the small feet of the Roman girls were neatly shod. No wonder!

The Ministro dell'Aeronautica is a modern building. It stands in its own grounds, close to the new University. Although it is smaller than the German Air Ministry (it is older), the Italian Air Ministry makes our Adastral House in Kingsway look like a second-hand afterthought. Perhaps, as people are said to get the government they deserve, air ministries get the building they deserve! Let's hope our Air Ministry will deserve a new building soon.

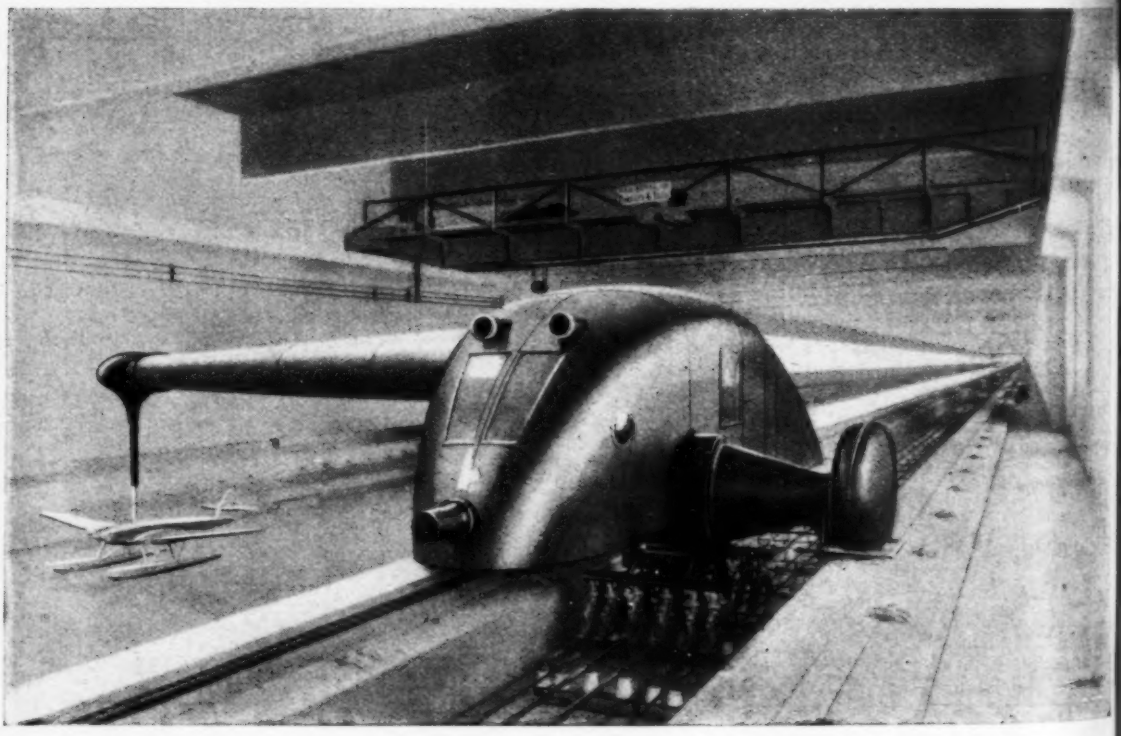
In the Air Ministry in Rome I received every courtesy. Coronello Rampelli and his assistant, Professor Rinieri de'Rocchi, met my every wish with the greatest kindness.



The en... to Guid... Italy's n... air labo...

(*Below*)

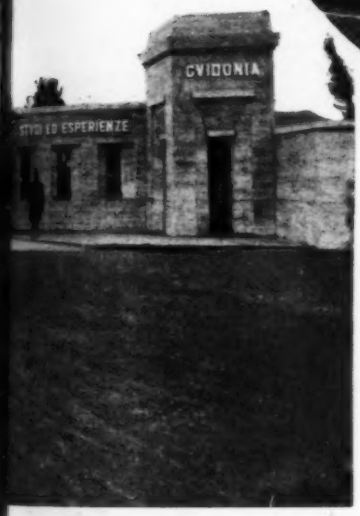
The beautifully streamlined high-speed car of the hydrodynamic tank. The method of conveying current to the motor can be seen, together with the external spatted wheel. The car is mounted on two additional wheels shrouded within the main streamlined portion. A seaplane model is on the test arm.



SEARCH OF ERMAN AND ALIAN AVIATION PART VI

By CAPTAIN NORMAN MACMILLAN, C., A.F.C., A.F.R.Ae.S., F.R.S.A.

The administration building, Lt.-General Cristoforo Ferrari's headquarters.



His Excellency General Valle (Under Secretary of State for Air—*Il Duce* is S. of S.) received me in his beautifully appointed rooms. During an interesting conversation General Valle told me that Italian workmen are peculiarly adaptable for modern aircraft work because the origins of Italian industry were rooted in the traditional *artigianato* (craftsmanship) handed down over generations. He quoted one interesting case of a small factory in Piedmont. During the Great War it made parts for aircraft, and expanded to about 1,000 workmen. After the war it reduced to 300 workmen, but kept the factory and tools. During the Abyssinian campaign this factory came into full operation and again grew to 1,000 workmen. During the period of reduction many of its hands returned to work in the fields.

Before I left the Air Ministry General Valle gave me permission to pay a visit to the national air laboratory at Guidonia.

The name Guidonia is a lasting tribute to one of Italy's foremost air pilots, General Guidoni. Those who knew him (both Britishers and Italians) have told me what a fine man he was. Ever in the forefront of Italian air development, he was dissatisfied with the design of a parachute. He knew there was something wrong with it. Determined not to impose the risk of testing it upon any other officer, he placed all his affairs in order, then ascended in an aeroplane to try out the parachute. He jumped. The parachute failed. Where he fell now stands a monument commemorating the gallant general to whom the success of Italy's standard parachute is due, and for which he gave his life.

Two years ago this air laboratory did not exist. Signor Mussolini ordered it to be built for the purpose of pushing Italian aeronautical development ahead with the utmost rapidity. Now it is commanded by Lieut.-General Cristoforo Ferrari, under whom is a staff of about 350, comprising both military and civilian personnel.

General Ferrari received me in his office in the administration building. Speaking in French, he described the layout of Guidonia. By means of a painting, which showed an isometric view of the complete laboratory, he indicated the different sections of his command. Each research group is housed in a separate building. One could readily spend a week examining the detail of the work of different departments.

The buildings are of modern architectural design, their severity of line offset by well-balanced proportions. Care has been taken to create a garden landscape outside the buildings, and the aromatic perfume from the trees that have been planted created a pleasant scent in the mellow winter air. In the near distance the morning mist rose from the Apennines, and disclosed peaks against whose bulk the great proportions of the buildings seemed to merge as in an intended setting.

Let us walk round the station as I saw it and inspect the different departments at work.

Radio Research

First we drove to the radio research building. It is staffed by young men under the leadership of an extremely keen and alert officer of not more than thirty years of age. Under his guidance we walked round the clean, well-lighted, ventilated and heated departments of the building, inspecting radio sets that had been assembled and approved for use in fighters, bombers and civil aircraft; examined ground station equipment; and saw some of the development work taking place for the production of still more efficient and more compact apparatus. There were Faraday screens, frequency-measuring machines of American design, an acoustic room where the tonal properties of sets can be tested free from echo interference, workshops for the manufacture of sets, and generating plant for current.

Following development work in the radio section at Guidonia, designs of experimental sets known to be entirely satisfactory for the purpose for which they were constructed are passed to civil constructing companies for manufacture. Before being installed in aircraft for Service use, each manufactured set is tested at Guidonia and approved.

Thence we passed to the physical laboratory, housed in another building. Here are standard machines known to all engineers for the purpose of testing ferrous and non-ferrous metals. There are numerous vibration machines for determining the properties of materials against fatigue; in some of them the tests are made under controlled conditions of temperature. There is a special machine, designed at Guidonia, for the purpose of testing aircraft control cables under working conditions. One long, horizontal machine operated by an hydraulic ram tests parachutes in the action of opening, a silent reminder of the man who gave his name to the station.

Leaving that building, we walked to the nearer end of the hydrodynamic test house. This building contains a test tank 442.5 metres long, 6 metres wide and 3.75 metres deep (1,638 ft. by 19 ft. 8 in. by 12 ft. 4 in.). Inside the tank, which is made of concrete, are transverse under-water ramps to prevent surge during tests. Across the tank stood one of the two testing cars, the slow-speed car, a partially streamlined vehicle mounted on four pneumatic tyres. Auxiliary metal wheels which just clear a metal rail on each side of the tank obviate the possibility of a crash following the bursting of a tyre. The test apparatus is mounted inside the car, and, in the usual manner, records of the tests are automatically plotted on revolving drums during the course of a run. The unit to be tested is mounted on an arm which projects beneath the car.

At the far end of the tank stood the high-speed car, a fully streamlined vehicle that, externally, looks like the latest thing in rear-drive motor cars. Like the slow-speed model, it is driven by electric motors acting direct on the driving wheels; but, instead of straddling the tank, the high-speed car is mounted on a runway on one side of the tank, with its operating arm projecting from one side. Inside the car, of course, are the necessary recording instruments.

The slow-speed car travels at a maximum speed of 31 m.p.h., while the high-speed car reaches 67 m.p.h. The controlling mechanism is grouped on a kind of observation bridge at one end of the tank. Controls to regulate the current supplied to the driving motors are mounted on a panel, together with electric braking mechanism and speed indicators; an electric diagram on the top of the panel indicates during the course of a run the exact position of the car at all times, so that the control operator need not take his eyes off the controls. During the last 50 metres of the run at each end of the tank the cars are automatically braked, but the control operator can apply additional braking power. He can also apply braking power at any other part of the run.

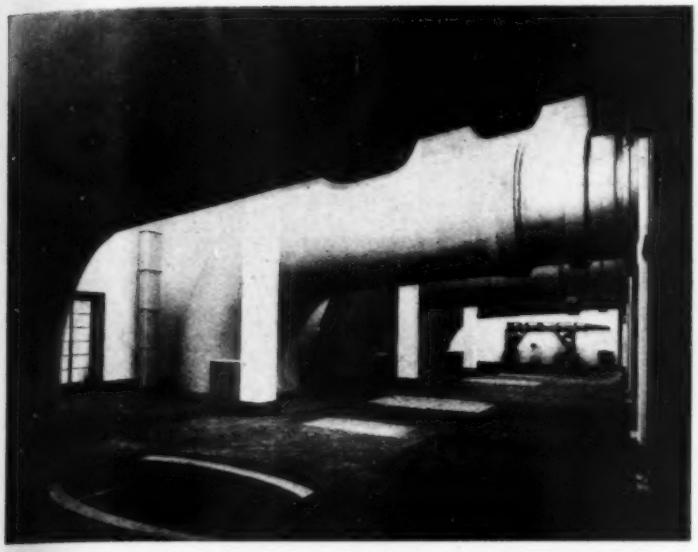
As an additional check upon speed a cinematograph camera mounted in each car photographs the run simultaneously against a clock and against marks placed on the side of the tank. This provides a completely accurate check upon the speed throughout the whole of the run. The high-speed car enables the test models to reach scale take-off speeds.

Beneath the tank is the power house, complete with its own generating and transformer plant to provide the power needed for the driving of the two cars.

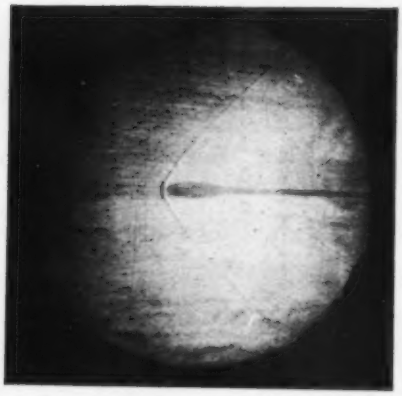
Here, in the hydrodynamic section at Guidonia, are evolved the latest Italian types of floats and hulls.

After having seen this remarkable plant one would venture to forecast that still more efficient seaplanes and flying-boats will be built by Italian engineers, whose marine aircraft have many years since made formation flights from Italy to Rio de Janeiro and to Chicago and back again.

The radio department at Guidonia is set in garden-like surroundings. The view above shows the interior of one of the numerous laboratories. In the radio department both aircraft and ground sets are studied, designed and kept up to date



This view gives an excellent impression of the futuristic aspect of the battery of four two-metre wind tunnels.



A remarkable photograph of the breaking air wave about an object in the supersonic wind tunnel at an air speed of 1,594 ft./sec. (1,087 m.p.h.). This wave is visible to the naked eye but the strata of the air are not defined as in the photograph. No smoke or other visual aid is employed.

Leaving the hydrodynamic section, we next entered the main building of the aerodynamic department. In one room are four two-metre wind tunnels, in each of which a 450 h.p. motor provides an air stream of 230 ft./sec. (157 m.p.h.). Among the objects under aerodynamic test at the time of my visit was an aircraft bomb. There was something very impressive and futuristic about the appearance of the room with its four tunnels passing across it and curving with perfect symmetry to the floor. It made one feel that one was in a laboratory of the future, a place whence designs might emanate that would alter the characteristics of the life of the people of the world; there was about it something Wellsian, altogether out of the ordinary.

Thence we passed through the wind-tunnel power room, and I found myself near the other end of the hydrodynamic department, where a circular tank was under construction. Inside this tank was a central vertical post about which models of floats and hulls will be rotated to determine the side-loads imposed when turning upon the water.

In another department of the aerodynamic section is a vertical wind tunnel for spinning tests, having a velocity of 83 ft./sec. (56½ m.p.h.). Its diameter is 3 metres and its motor of 150 h.p.

Out in the open air again there was a curious structure that looked rather like a scrubbing plant in a chemical works. Built of concrete, with an inspection house, this was the high-speed duplex tunnel, which, on 1,800 h.p., gives a velocity of 328 ft./sec. (224 m.p.h.).

Thence we passed to the last section of the aerodynamic department, where there is housed the extremely interesting supersonic wind tunnel, that is, a tunnel through which the air flows with a velocity higher than that of sound. Sound travels through the atmosphere at a speed of about 743 m.p.h., but the speed of the air flow through this tunnel is far greater. Actually it can reach a speed of about 2,096 ft./sec. (1,428 m.p.h.).

To enable this terrific velocity to be reached certain intermediate steps are necessary. The airflow cannot be created by an ordinary propeller. It has to be generated by a 13-bladed turbo-compressor, rather like a turbine. This compressor is driven by a motor of 3,125 h.p., which, running at 900 r.p.m., drives the turbo-compressor through gearing at 3,900 r.p.m. But even this would not permit the air to reach its terrific speed in the tunnel if the air passing through the compressor was at normal sea-level density and pressure.

The first stage is, therefore, to reduce the density and pressure of the air entering the turbo-compressor to one-tenth that of normal air at sea level; that is, equal to the density found at about 60,000 feet. During the passage of the air through the turbo-compressor the pressure generated to create the velocity raises the temperature of the air to 180 deg. Centigrade. This temperature is much too high for the purposes required. The air leaving the turbo-compressor is, therefore, passed through a battery of four refrigerators, and during its expansion after leaving the refrigerators its temperature drops to −150 deg. Centigrade.

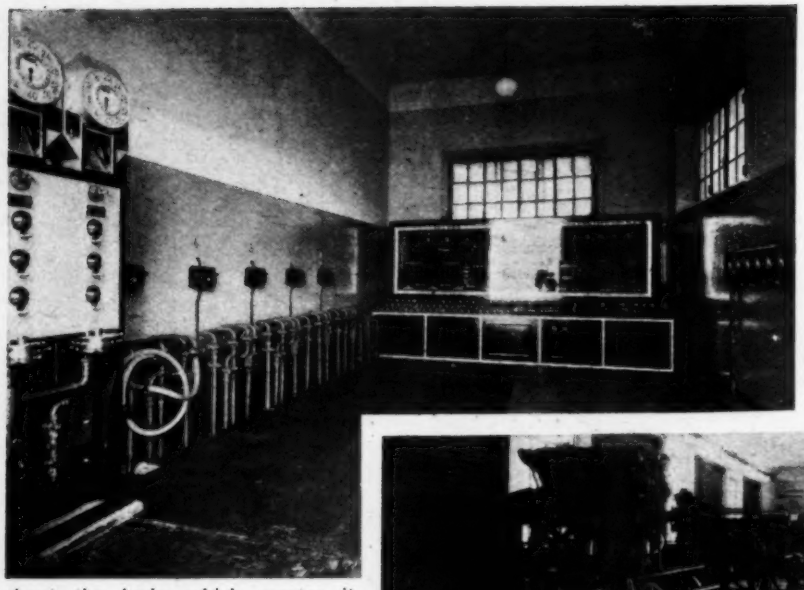
Thus, in the course of a few feet of travel through the entry end of the apparatus there is a variation in temperature of 330 deg. Centigrade, or nearly 600 deg. Fahrenheit. Finally, the air, travelling at its terrific velocity, passes through the observation section of the tunnel. This is a square section with sides measuring 40 cm. (15.75in.).

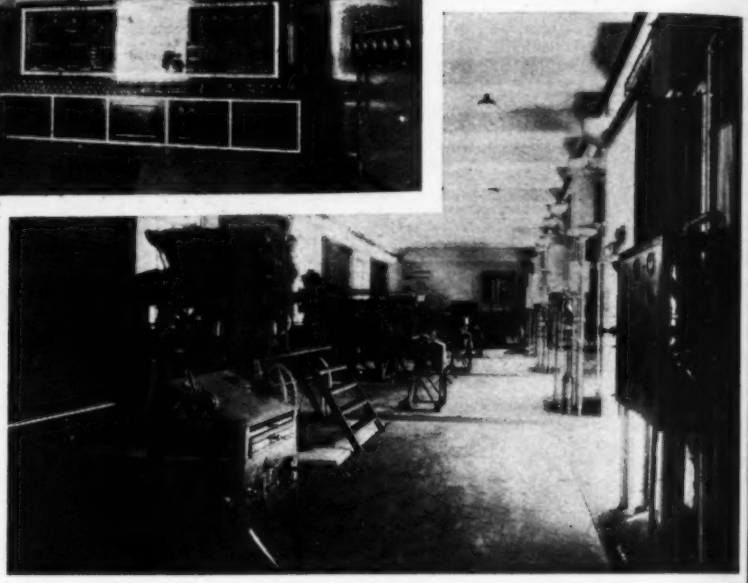
The Why and Wherefore

The uninitiated may wonder why an apparatus of this kind is required for the investigation of aircraft problems when aeroplanes have not reached a speed of more than 440 m.p.h. in level flight (the speed which, incidentally, was reached by the Italian Macchi seaplane that broke the world speed record previously held by Britain). The reason is twofold. First, although aircraft have not reached this speed, the tips of airscrews do reach and even exceed the speed of sound. Secondly, the apparatus is a means to explore the problems of flight in the stratosphere, where the density of the atmosphere falls approximately to that obtaining in the wind tunnel, and where Italian scientists hope that much higher aircraft speeds will be obtained.

On each side of the square section of the tunnel are portholes, through the thick glass of which investigators observe the phenomena of ultra-high-speed air flow. On one side of the room, opposite one porthole, is a powerful arc lamp and mirror reflector. On the other side a camera is mounted.

The breaking wave in the airflow that occurs at the speed of sound can be observed within this tunnel. It can be seen by the naked eye, but infra-red photography records still more detail. Areas of varying pressure and turbulence are disclosed by means of the camera. At the speed of sound a wave develops in the air, visible just as a bow wave from a ship is visible. At the speed of sound this wave is at right angles to the nose of the body about which the airflow is passing. As the air speed increases the wave bends back until at the maximum speeds which can be reached in this particular tunnel the wave lies close





In the engine test department. On the extreme left of the fuel control station are the main intake cocks. In the background is the control board which determines quantities and mixtures for each engine. It indicates electrically the flow of each type of fuel, the feed lines in the diagram lighting up automatically.

about the body which creates it.

This is an ocular demonstration that there is a peculiarly high resistance to a body passing through the air in the region of 743 m.p.h. At speeds which greatly exceed the speed of sound, however, resistance is reduced.

From this one can infer with reasonable certainty that a very great increase in horse-power will be required to increase aircraft speed from, say, 700 to 800 m.p.h. Thereafter the relative power increase required to increase speed will not be so great. So, perhaps, we may hope that one day it will become feasible to fly at speeds in the order of 1,000 m.p.h., provided the power required to get over the initial air wave created at the speed of sound can be produced.

From the supersonic wind tunnel department we passed to the engine test department. The latter comprises a number of different sections, each designed and equipped for a specific purpose. One test shop is equipped with dynamometers (both hydraulic and electric) of various types for the testing of engines of small and large power output. The plant includes dynamometers made in England, Germany, and America.

Engines under test ranged from the 1,000 h.p. Fiats (both liquid- and air-cooled) to the 200 h.p. air-cooled Isotta Fraschini. Engine designs ranged from twelve-cylinder, liquid-cooled vees to eighteen-cylinder, double-bank, air-cooled radials; they included the products of the Fiat, Piaggio, Isotta Fraschini and Alfa Romeo factories.

In a separate test house engines were mounted for endurance tests under load imparted by airscrews.

In the laboratory of the engine test department I saw a single-cylinder fuel-testing engine and plant, and another test engine with an adjustable cylinder head to give variable compression ratios.

Outside was an open hangar in which two 1,000 h.p. Fiat engines were mounted side by side driving through gearing a single metal airscrew. New types of metal airscrews are tested on this plant. Overloads can be applied on account of the ample horse-power available, and concrete walls and heavy steel nets ensure safety.

The last shop we visited contained a vibration testing apparatus to determine the effective life of flexible fuel feed tubing.

The fuel fed to the different engine stands is controlled throughout the whole engine test department from a central master control station. Three different fuels—petrol, benzol, and alcohol—are employed, mixed in varying proportions to determine the best results. Each of the three fuels is fed from the underground storage tanks through master control cocks to the control board at the end of the control house. This board enables the exact mixture to be fed to every engine unit. A diagram of the fuel feed lines indicates the flow of fuel from the control house to each test station. When the controls are operated, the channel ways on the diagram automatically light up electrically, so that the mechanic operating the control station can see instantly, as can any inspector who visits the control station, precisely what type of fuel is being fed to any given engine, and that the flow is functioning satisfactorily.

From the engine test house we drove to the *mesa* (mess), just within the entrance to Guidonia, for lunch.

[*The next article in this series will describe Montecello Aerodrome and the Caproni Works at Milan.*]

For Service Rescue Work

ASBESTOS fire-rescue suits are now being extensively adopted by the Royal Air Force.

An order for nearly 200 has just been placed with Bell's Asbestos and Engineering Supplies, Ltd., of Slough, and when delivery has been made, two of these suits will be allocated to each Service aerodrome.

When flying is in progress, two of the airmen detailed for duty with the fire tender will wear the lower portion of these asbestos suits as a precautionary measure. In the event of a crash they will quickly slip on the top portion and will then be able to work for as long as two to three minutes in heat of great intensity.

New Rules

FOR the benefit of those who did not see the paragraph in the issue of March 4, pilots are reminded that various new rules, given in the Air Navigation (Amendment) Order, 1937, come into operation next Thursday.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

THE WEARING OF THE GREEN: An Avro Anson (two 310/355 h.p. moderately supercharged Siddeley Cheetah IXs) on test at Woodford prior to delivery to the Irish Free State Air Force, which is composed almost entirely of Avro aircraft. All its machines, including some Vickers Vespas, have Siddeley engines. (*Flight* photograph.)

EXPERIMENTAL "hookings-on-to" and "droppings-off-from" the Zeppelin *Hindenburg* have been made by Colonel Udet in a Focke Wulf Stieglitz biplane.

Mat Berry, a veteran pilot in the arctic regions of Canada, has been awarded the McKee Trans-Canada Trophy for 1936 in recognition of some outstanding rescue work.

Miss Mabel and Miss Sheila Glass, who put up such a commendable performance in the recent Egyptian International Meeting, are planning to attack Mrs. Mollison's Cape record of 3 days 6 hr. 26 min.

At two thousand feet, between Gautemala and Vera Cruz, a baby tuna fish entered an air liner *via* a cockpit window, bespattering the pilot with fish scales. Unromantic explanation of glamorous story: one of a flight of frigate birds flying above became frightened and dropped his supper.

Major Al Williams, in our contemporary, *U.S. Air Services*, says that it took him one hour to "buck fourteen miles of traffic in a bus from the center of London to the Croydon Airport" and that it took him only one hour and forty-five minutes to fly to Rotterdam, two hundred and five miles away.

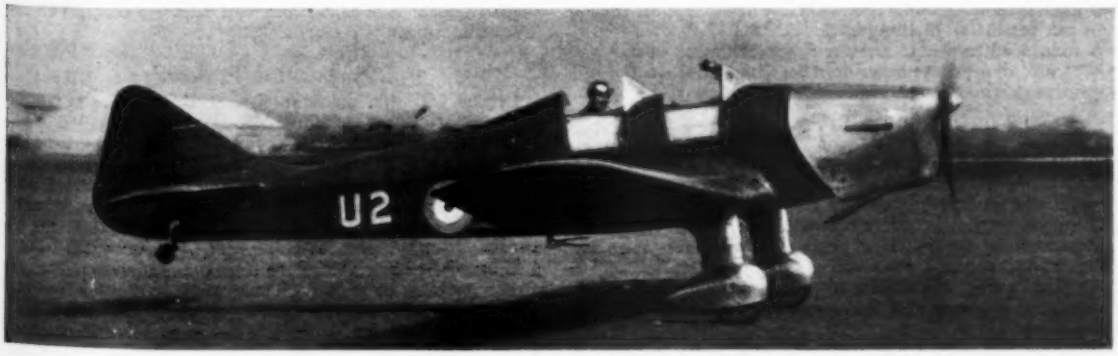
The first annual general meeting of the Association of Aeronautical Ground Engineers will be held on Monday, April 5, at 7.30 p.m., at the Feathers Hotel, Broadway, London, S.W.1. Information and forms of application for membership may be obtained from the honorary secretary, Mr. R. S. Moore, E.3 Maisonette, Croydon Road, West Wickham, Kent.

His Majesty the King has been graciously pleased to become Patron of the R.Ae.S. It was in 1918 that His Late Majesty King George V graciously conferred the prefix "Royal" to the title of the Aeronautical Society. In 1926 His present Majesty, then H.R.H. The Duke of York, became a Patron of the Society.

Twenty-five Years Ago

(*From "Flight" of March 23, 1912.*)

"I hear that the Avro works at Manchester are pushing well ahead with the three biplanes for which they have received orders from the War Office. These are to be much the same type as the new 60 h.p. E.N.V. model, which has shown itself excellent in its preliminary trials, under the direction of Lt. Wilfred Parke, at Brooklands. It is tremendously fast, the average of the various speeds estimated by observers is somewhere near 66 miles an hour."



MAGISTER ARTIUM: Mr. F. G. Miles, past-master of the art of aircraft demonstration, reveals the qualities of the Miles Magister trainer (D.H. Gipsy Major) at a "family gathering" of Phillips and Powis employees last week when the prototype was christened with due ceremony by Mrs. Miles. The Magister is basically similar to the Hawk Trainer, but has been revised in detail. Note, for example, the new undercarriage and the tail wheel. (*Flight* photograph.)

CLOGGING the WHEELS

The Topical Subject of Aircraft Production Delays Examined: Some Practical Remedies

By KISMET

IN this endeavour to show what is at present holding up Britain in her belated effort to re-arm in the air I am concerned only with general causes, and not specific or particular problems that might be peculiar to one firm of manufacturers.

Having been with a representative selection of the leading Government contractors in various capacities, I am giving a consensus of those opinions that I have heard expressed from time to time.

First, as regards personnel: The primary requisite in a firm's employees should be adaptability to environment and duties. Should a dozen men, taken at random from an aircraft erection bay, be asked their previous occupations, the answers might well cover such trades as coal miner, waiter, bootmaker, and dockyard riveter. They will most likely be worthy and painstaking men, eager to please and do the right thing, but needing to have hours spent in explanations of strange terms, reading blue-prints, and all the basic elements of a fitter's job. After some days of more skilled people's time have been mainly used to instil into their heads such items as how to lock a nut, in the absence of a locking-washer, by "centre-popping," wiring, or burring-over, they will take a deep breath and begin.

SAND IN THE WORKS:

Untrained Fitters
Too-long Working Periods
Worshipping the Experimental Idol
Drawing-office Double-Dutch
Haphazard Tool Handling
Bonus-system Drawbacks

I have seen, not only once, micrometers being used as vices to hold a rib that is being offered-up prior to fixing in place. In due course the "mikes" are found to be a few thousandths out, and more time will be wasted resetting them.

Their ideas simply do not run to keeping delicate instruments for any particular use; with the best will in the world they think it *saves* time to make shift anyhow rather than ask for the right thing at the stores.

A man used to sledge hammers, for instance, cannot get the "feel" of a tap hammer used for ¼in. Dural rivets until some weeks' practice has been given to him.

Skilled Labour

So it may be stated that if there is such a shortage of skilled labour that people from the backwoods are being pressed into service they should at least be given a month's training on some crashed or obsolete machine, rather than be turned loose on the latest designs where a mistake may bring production to a standstill.

Another point applicable to everyone who has work demanding a measure of concentration is the question of hours.

Working hours and overtime will always be a bone of bitter contention, but is it not asking the impossible to expect men to work from 8 a.m. until 8 p.m. for five days a week (less an hour break at midday), plus five to nine hours on Saturday, and, in some instances, plus four hours on Sunday morning? It is hardly surprising that the output suffers every time, and things even out in the sense that men cannot and will not do more in 10½ or 11 hours than they would do in 8½ or 9. They get stale, take an hour in the evening to do what took twenty minutes in the morning, and cultivate the gentle art of lead-swinging.

"Appear busy and it won't matter twopence if you really ain't, 'cos the boss gets as tired as us." Thus spoke a foreman under whom I once worked, and in the last part of his remark he was absolutely right. The shop manager, if not engaged in actual fitting, at least put in as many hours as did the rest, and, after we had all left, stayed on to hand over to the night shift.

Next, there is the effect of experimental work on production. If a factory has an extra-special "last word in modern development" machine that it is hoped will take the Air Ministry by storm one of two things generally happens.

Either it never gets further towards reality than the drawing-office archives, or, what is infinitely worse, it is built in an atmosphere of pseudo-secrecy with a sort of *carte blanche* label tied all over it.

Result, utter confusion throughout the whole establishment. Everywhere are notices exhorting the staff to lay aside all they possess, so to speak, and concentrate on the favourite child.

Experimental Preference

Let us call this machine the XYZ. In the inspection department, stores, machine shop, anodex shop—in short, at all points of the compass—we see "Pass XYZ jobs first," or "Clear XYZ," or just "XYZ first."

If a man, lucky enough to be one of the select few who are slowly shaping the XYZ into a flying machine, requires 18 inches of copper wire, he requisitions a reel, and in answer to any awkward question murmurs the magic formula, "For the XYZ." In due course there is a shortage of copper wire, or it may be split pins, or Sisaflex, because of this prodigal waste. Then, maybe, two dozen ABC trainers are held up incomplete because the entire stock of some trivial thing has been squandered on the experimental XYZ.

Another example may be permitted. If some longish components of the XYZ have to be anodised or normalised it may mean emptying a whole trough of small parts to

accommodate them. They cannot, of course, take their turn, but must be dealt with at once, if not sooner.

Experiments must be made and there must always be experimental aircraft, but could their production not wait until the vital shortage of tried and proved fighting machines has been made good?

If they simply cannot be kept waiting, could they not be produced separately and right away from the "bread and butter" jobs, with a self-contained inspection room, stores, etc.? Material could then be obtained in known quantities from the usual outside suppliers, and used for the XYZ direct.

Dimensional Theory

Our third point affects the design staff. For some occult reason every drawing office whose work I have had the doubtful privilege of translating suffers from a maddening complex.

It is that they will not use one medium of expression in terms of the first, second or third dimension.

To take a very simple instance of the untold wasting of time caused by this deplorable habit, let us assume that a piece of Dural sheet of a thickness of $\frac{3}{16}$in. has to be cut to a rectangular shape.

The blue-print will have a small space headed "Material Specification," in which will be the information given above, i.e., "Dural $\frac{3}{16}$in. sheet."

The length of the rectangle required will be given, let us say, as 1.750 in. and the width as 28.575 mm. The whole is required to have a common tolerance of plus or minus five thousandths of an inch.

First, the man to whom the job is assigned will check the thickness of the sheet issued, using a micrometer graduated in thousandths or ten-thousandths of an inch. This involves a little sum converting a vulgar fraction into a decimal reading. The second measurement he can check with a vernier, and this should be no bother to him. Next he must convert 28.575 mm. into inches and decimals thereof.

Now, all this will take time, the book of conversion tables is probably lost, or the page he wants is missing, so perhaps he goes to the charge-hand, who, proud of his superior learning, does the calculation on the wall and gets it wrong.

Try multiplying this delay by a number equal to that of the men engaged on machine jobs, milling, grinding, and so forth, then, again, by the inspectors who have to check the finished article. Now take a really complicated drawing giving twenty or thirty dimensions, including radii, diameters, and chamfer angles, and try to get an idea of the kind of mass-meeting that congregates round the blue-print all "helping" to find out what the whole thing means in terms that they understand and to which they can work with the instruments provided.

Calling-in the D.O.

After a suitable lapse of time someone will 'phone the drawing office, and the man who produced the drawing will come along (in his own good time) and indulge in cheap sarcasms at the expense of the puzzled one. Of course, ultimately the man gets to know the job more or less by heart, and his gauges will show if he is going off the rails. But it may take weeks before he is fully conversant with a particular component, or assembly of components, during which period he spends half his time struggling with a nightmare of meaningless figures. If only the drawings and blue-prints would show *all* dimensions in the decimal system!

If this is held to be impossible, then show *every* equivalent. It cannot possibly take one draughtsman longer to work out the whole collection of figures once than it takes for a fitter or machine operator to work them out daily, recruiting as much help as he can from his fellow workers for an indefinite period.

A lesser handicap is very often imposed by failing to give the overall figures at all, so that if we assume the desired information equal to AE, the method of finding AE involves adding AB (1.257 in.) + BC (3 7/32 in.) + CD (which we will call the diameter of a circle with a radius of 27.34 mm.) + DE (which is again in decimals).

Our fourth question concerns the fact that "A bad workman always blames his tools." If the old saw is true, all workmen engaged on aircraft production are bad.

Tools may be divided into two categories, the firm's and the worker's own.

Taking the latter first, there is no kind of standard tool kit set down in print as the model outfit. Everyone has his own ideas, and no two kits are anything like the same. If Bill, George, Tom, and Frank are fitters, all engaged upon erection work connected with the ABC single-seater fighter, Tom will have half a dozen Woolworth vices and no screwdriver; George boasts three hammers and one vice; Bill has no punches or spirit level, while Frank seems overburdened with six of everything.

Bill, George and Tom cheerfully lend and borrow among themselves, "making do" and "worrying through" somehow, wasting time sorting out each other's belongings and all wanting the spirit level at once. Frank gets straight on with his job, earns his bonus, and has a good chance of promotion.

But it is a bit rough on the others. Why not give a man a printed list of what he *must* have when he joins the firm, and have a periodical kit inspection once a week, letting a man replace at cost price anything he may have lost, damaged or broken?

Our friend Frank is perhaps a trained engineer, who has served his time as an apprentice and been an aircraft fitter for years. He knows what is what without being told, but George, Bill, and Tom have come to help their country out in an emergency and will do their cheerful best; but it could be made a much better best by a little guidance on the subject of equipment.

Works Tools

As regards the gear provided by aircraft firms it is difficult to generalise. In a small shop, building only one special machine, the apple of a certain firm's eye was four dozen pairs of riveting toggles. At another concern the entire works, for both military and civil aircraft, had two pairs only, 95 per cent. of riveting being snapped by hand, with a boy to hold up the dolly. When I was there they had perhaps eighty machines in various stages of assembly, and I would not care to estimate the time wasted by the use of snaps throughout all the stages of production.

Another star example was a firm which kindly provided an electric or hydraulic riveter for nearly every fitter, but whose efforts stopped short of having more than one-third of the plug points needed. Anyone strong enough to secure a plug point first thing in the day lost it the moment his back was turned.

There is one type of person who is suited down to the ground by these methodless methods. Always, in any walk of life, one finds men who somehow establish a reputation for hard work, while in point of fact they do hardly a stroke. Such a one will wander about for half an hour holding a lead lamp, ostensibly looking for an empty socket into which he can plug the cable. Having decided they are all in use, he changes his search, and hunts for a junction piece, and if lucky enough to find one, will spend another twenty minutes tinkering about with adhesive tape, binding it here and there, poking at it with a screwdriver and "cleaning" the points.

Next, he finds a join in someone else's cable line, breaks it, and inserts his junction piece. As soon as the cable line is severed pandemonium is let loose. Follow long-winded explanations and profuse apologies to the man whose light has gone out, or whose drill has stopped.

By the time both sections of cable are live, and our lead-swinging friend is ready to use his lamp, he suddenly discovers that the cable is not long enough to reach his job.

This kind of thing happens *ad nauseam* with some people, and they always have such wonderful excuses, but two such men in a busy shop can do untold damage in holding up production.

Of course, it is comparatively soon spotted, perhaps after two or three weeks, and possibly the man is dismissed; but so easy is it to get taken on at almost any aircraft works that this is only passing the trouble on.

In view of such occurrences, it seems a pity that every man cannot have a working number (not a *works* number) stamped on to a card, and a note entered on the card each time he leaves a job, giving the reason for his leaving. The number could easily be the same as that upon his National Health card, which would avoid any chance of duplication.

Strange as it may seem, no reference or testimonial ever gets asked for in the aircraft industry as far as the fitter, machine-shop operator or labourer (as apart from the staff) is concerned. He just writes down the last two places at which he worked, and starts right away.

Even if the previous employers *are* consulted, and disclose that a man was dismissed for gross negligence, he has had two or three days in which to do his worst, and sometimes that same worst has to be seen (and occasionally heard and smelt) to be believed.

Caught Out

It is, of course, all due to the fact that the Industry has been caught out by a Government that has itself been startled from a deep sleep into sudden wakefulness. The apprentice system has died out, and no steps have been taken to train any of the younger generation in the way that they should go. There are, as we all know, thousands of boys in the factories, but they have little or no chance of systematic instruction, and have to pick up whatever they learn by a process of trial and error—mostly error.

Having myself made all the mistakes that they make, I can sympathise with them, especially as in my own case it *was* somebody's job to see that I did not make the same mistake twice, let alone go on making it over and over again for hours, and perhaps ruining a whole batch of detail parts before the inspection department finds out.

This is not put down in any kind of exaggerated way, because it is happening all over the country, and work is so easy to get that the firms know their employees will walk out as soon as look at them.

Standard wages, and scrapping the bonus system, might help.

Human nature being human nature, a man is constantly alert for something better. If another firm pays the same wage as his present employer, he thinks that he may make more *bonus*. Off he runs to give it a trial, and if he fails to get what he hoped to get, off he runs again. Perhaps he comes back to his original firm, to do the same work and get a higher rate of pay for doing it, having demonstrated his independence. Fired by his example, off go some of his friends, and the merry game moves on and on.

What can be done to stop it?

Who will work for, let us suppose, 1s. 4d. per hour, when men up the road get 1s. 6d. for the same job?

Just when a man has settled down to a particular routine and atmosphere, his place is vacated and a newcomer has to fit in, find his feet, and generally pick up the threads, or be jammed in and have the threads pushed into his hands.

* * *

So far I have dealt only with the troubles and scrapes into which the men actually engaged on production fall. The final result is an industry with only about three-fifths of its possible efficiency, meaning three-fifths of possible production.

To sum up the improvements that should be made at once, and could be made with no extra expense in the long run:—

(*a*) Give a chance for all men new to aircraft construction to have just a little instruction in basic methods.

(*b*) Don't work men until their eyelids are drooping with utter weariness. Work them only while they can concentrate on their jobs.

(*c*) Segregate experimental work.

(*d*) Standardise measurements in inches and decimals of an inch.

(*e*) Tell men what tools they *must* have, and see they have them.

(*f*) Provide other tools and equipment as the demand requires.

(*g*) Root out the time-wasters.

(*h*) Pay a good standard wage, and scrap the bonus system.

The Price of the Phoenix

IT should be pointed out that the price given for the Heston Phœnix on p. 257 of last week's issue is that for the latest machine fitted with the Series II Gipsy Six with v.p. airscrew and not for the standard model, which is priced at £1,700. The performance figures given were for the latter; the latest type cruises at 135-140 m.p.h.

Forthcoming Events

March 27-30. Yorkshire Gliding Club: Easter Meeting, Sutton Bank.
March 30—April 12. Ely Aero Club: Easter Instructional Course.
April 3. Rugby: R.A.F. v. Army, Twickenham.
April 6. R.Ae.S. Students' Section Debate: "Speed v. Safety," 7 p.m., R.Ae.S. Library.
April 8. R.Ae.S. Lecture*: "Control Problems," by Mr. A. G. Pugsley.
April 10. Aero Golfing Society: Martlesham Match.
April 15. R.Ae.S. (Coventry Branch) Lecture: "Production and Inspection Methods Applied to Screw Threads," by S. J. Harley. Armstrong Siddeley Canteen, 8.15 p.m.
April 15. Italian Aero Club: Sahara Rally.
April 22. R.Ae.S. Lecture*: "Power Plant Trends," by Mr. G. J. Mead.
May 6. Aero Golfing Society: Instone Trophy.
May 9. R.Ae.S. Garden Party, Great West Aerodrome, Hayes.
May 12-19. Austrian Aero Club: Austrian Whitsun Flight.
May 13. Leicester Airport Coronation Air Display.
May 15. Cardiff Aero Club: Coronation Rally.
May 15-18. Yorkshire Gliding Club: Whitsun Meeting, Sutton Bank.
May 26—June 6. Brussels Aero Show.
May 26-30. Austrian Aero Club: Salzburg Gliding Contest.
May 27. R.Ae.S. Wilbur Wright Lecture: "Turbulence," by Dr. Theodor von Karman. Science Museum, South Kensington.
May 29. Empire Air Day.
May 29-31. London-Isle of Man Race and Round-the-Island Contests.
June 4-6. York and Leeming F. Clubs: International Meeting, York.
June 11-14. Hungarian Aero Club: International Conference.
June 12. Bristol and Wessex Aeroplane Club: Garden Party, Whitchurch.
June 15-20. Magyar Pilota Picnic, Hungary.
June 20. R.Ae.C. of Belgium: Gordon Bennett Balloon Race, Brussels.
June 21-28. Federation Aeronautique Internationale: London Conference.
June 26. Royal Air Force Display, Hendon.
June 28. S.B.A.C. Display, Hatfield.
July 1. Aero Golfing Society: *Flight* Trophy.
July 3. Newcastle-on-Tyne Aero Club: London-Newcastle Race.
July 3. Ramsgate Airport, Official Opening.
July 4-18. Aero Club of Germany: Wasserkuppe Gliding Meeting.
July 10. Cardiff Aeroplane Club: London-Cardiff Race.
July 11. Italian Aero Club: Circuit of Rome.
July 15. Aero Golfing Society: Jubilee Cup.
July 17. Portsmouth Aero Club: Garden Party.
July 19-28. Federated Touring Clubs of Belgium: Belgian Tour.
July 23—August 1. Swiss International Meeting.
July 24. Devon Air Day and Race: Plymouth, Exeter and Haldon.
July 31. Cinque Ports Flying Club: Folkestone Aero Trophy Race.
July 31—August 2. Yorkshire Gliding Club: Opening Meeting, Sutton Bank.
August 1-14. Yorkshire Gliding Club: Instructional Camp, Sutton Bank.
August 1-31. New York—Paris Air Race Flights.
August 6-7. Austrian Aero Club: International Rally, Lake Worth.
August 14-22. Yorkshire Gliding Club: Open Contest, Sutton Bank.
August 21. Thanet Aero Club: Aviation Meeting and Race.
August 21. Midland Aero Club: "At Home."
August 22-29. Italian Aero Club: Circuit of Littorio.
August 28 and 29. Cinque Ports Flying Club: Lympne International Rally and Wakefield Trophy Race.
September 10-11. R.Ae.C.: King's Cup Race.
September 12. Aero Club de France: Coupe Deutsch de la Meurthe, Etampes.
September 23. Aero Golfing Society: Cellon Trophy.

*These lectures take place in the Royal Society of Arts, 18, John S., London, W.C.2, at 6.30 p.m. Admission is by ticket obtainable through a member.

The AIRCRAFT ENGINEER

"FLIGHT" ENGINEERING SECTION

No. 134 (Volume XIV No. 3) 12th Year March 25, 1937

LONGITUDINAL STABILITY

An Investigation with Particular Reference to Low Wing Monoplanes

By W. R. ANDREWS, A.F.R.Ae.S.

EVEN the casual student of aeronautics cannot have failed to notice that modern low-wing monoplanes appear to be fitted with "outsizes" in tailplanes, and he may have wondered why. Many designers have found to their cost that although a new type had satisfactory stability in pitch at most speeds, it became unstable on climb, and cases are on record of such new machines being successively fitted with larger and larger tailplanes in an attempt to get longitudinal stability at all speeds. In the following article Mr. Andrews explains his theory concerning the reasons for a form of instability which has taken several designers by surprise.

We have had this article in hand for some months but have not had space for it until now. However, the subject is still a serious design problem and deserves close study.

Previous attempts have been made (Refs. 1 and 2) to obtain simple formulae for the design of tail surfaces to ensure satisfactory longitudinal stability. These earlier attempts were made before the vogue of low-wing monoplanes. As a consequence, it was not considered necessary to allow for the vertical position of the Centre of Gravity which did not appear in any of the formulae.

In view of the present popularity of the low-wing arrangement, it seems worth while to re-open the subject (making allowance for the vertical C.G. position), especially since certain low-wing designs have suffered from instability, although the "tail volume" (based on biplane data) has appeared satisfactory.

Any formula now derived must be capable of application to biplanes as well as to all types of monoplanes, so that the wealth of data collected in the past can be applied to the low-wing monoplane problem.

With this in view the present investigation has been carried out. Certain simplifying assumptions have been made, but it will be found that they are well within the accuracy to be expected from any simple formula adaptable to the requirements of the practical engineer

For a theoretical aeroplane having no inertia, neutral stability is obtained when (at constant speeds)

$$\frac{dK_{Mw}}{da} + \frac{dK_{MT}}{da} = 0$$

$\frac{dK_{Mw}}{da}$ = Slope of wing moment curve (about C.G.)

$\frac{dK_{MT}}{da}$ = Slope of tail moment curve (about C.G.)

This approximates to the condition when an aeroplane flies in a gusty atmosphere, such that the whole aeroplane is subjected to the same change in incidence without appreciable loss of speed. For complete stability $\frac{dK_{Mw}}{da} + \frac{dK_{MT}}{da}$ must be negative.

The pitching moment of inertia of the actual aeroplane materially affects the resulting stability. A simple investigation allowing for inertia is not possible and any other becomes so involved as to defeat the object of the present article, which is to produce a simple formula by means of which comparisons can be made.

In general we may write

$$\frac{dK_{Mw}}{da} + \frac{dK_{MT}}{da} = k \quad .. \quad .. \quad .. \quad .. \quad (1)$$

It will be shown that

$$\frac{dK_{Mw}}{da} = a_w\left(X - \frac{2}{a_o} Z K_L\right) \quad .. \quad .. \quad .. \quad (2)$$

where $a_w = dK_L/da$ for lifting system

$a_o = dK_L/da$ for infinite wing

X = distance (in terms of mean chord) the aerodynamic centre of wing ("Quarter" chord) is ahead of the C.G. measured parallel to no-lift line

Z = distance (in terms of mean chord) the induced tangential plane (see Note) is above C.G. (measured normal to no-lift).

And assuming a_T to be zero

$$\frac{dK_{MT}}{da} = \frac{S_T}{S_w} a_t (1 - b)\left(L + \frac{2ha_t}{a_o}\right) \quad .. \quad .. \quad (3)$$

where S_T = area of tailplane and elevator

S_w = total wing area

$a_t = \frac{dK_L}{da}$ for tailplane and elevator

$b = \frac{d\beta}{da}$ where β = downwash angle at tail plane

L = distance (in terms of mean chord) the "Quarter" chord (or C.P. if with floating elevators) of tailplane is ahead of the C.G. measured parallel to the no-lift line. (This dimension is negative in a conventional aeroplane.)

h = distance (in terms of mean chord) the "Quarter" chord of tailplane is above the C.G. measured normal to the no-lift line

a_t = tail setting angle, *i.e.*, angle subtended between no-lift angles of wing and tailplane plus elevators—radians.

A rather important point brought out by the above formulae is that a low-wing monoplane tends to become unstable at high values of the lift coefficient (that is at slow speeds), and the high-wing arrangement tends towards instability at low values of K_L (*i.e.*, in high speed flight).

This does not mean that all low-wing monoplanes are unstable at the stall and all high-wing arrangements unstable in the dive. What it does show, however, is that as the C.G. is moved aft the onset of instability will be at higher speeds with a high-wing monoplane than with a low-wing arrangement. At higher or lower speeds than the one at which instability first appears the aeroplane may be stable. For example, it may be found that a high-wing arrangement first shows signs of instability at maximum speed and a low-wing at climbing speed. The actual speed will be influenced by the vertical position of the C.G. more than by any other consideration.

Arguing in this way it would seem that the different wing arrangements should be compared at different values of K_L, the choice of K_L being dependent upon the vertical C.G. position. The writer has insufficient evidence at his disposal to show how this critical value of K_L varies with C.G. position. As a compromise it is, therefore, suggested that in the first instance comparisons should be made at $K_L = .5$, which roughly represents the climbing condition. This is, of course, arbitrary and subsequent experience may show that a better agreement is obtained with another value for K_L or by varying K_L with the vertical C.G. position.

NOTE.—$z_D = \frac{\int_0^y K_L^2 . z_D . dy}{\int_0^y K_L^2 dy}$ = Mean Induced Tangential force plane.

where z_D is height of ¼C (at distance y from centre-line) above that at root in chord.

The calculations will proceed on the assumption that the stability can be definitely represented by the value of k when $K_L = .5$.

It has been previously demonstrated (Ref. 3) that

$a_o = 57.3\ (.0506 - .565\ t^3)$ per radian

$= 2.82$ when $t = .13$ (average wing)

$= 2.86$ when $t = .10$ (average tail)

Combining (1), (2) and (3) with the above gives the final value of k (with a_T assumed zero) as

$$k = a_w\ (X - .355\ Z) + \frac{S_T}{S_w} a_T\ (1 - b)\ (L + .35\ \frac{A_T h}{a}) \quad (4)$$

A probable minimum (negative) value for k is $-.24$ but, until many aeroplanes have been analysed, it would be wise to accept this figure merely as a guide rather than as an infallible criterion.

In the comparison between wings having their C.G. at different heights above the mean plane, there are a few very interesting facts revealed. Take only $\frac{dK_M}{da} = a_w\ (X - .355\ Y)$, (since it is assumed that the same tail and tail volume will be used) if the C.G. is moved up 1 in., say, there must also be a forward movement of .355 in. to maintain the same stability at $K_L = .5$. There are many low-wing monoplanes designed from the old tail volume

$$T.V. = \frac{S_T L_t}{S\ C}$$

where the effect of the vertical position of the C.G. is disregarded.

The C.G. of the low-wing monoplane is perhaps .25 C higher than the biplanes from which the satisfactory tail volume coefficient, TV, was developed. Equation (4) shows that for the same slope of lift curve, the C.G. ought to have moved forward 0.089 C in order to have retained satisfactory stability. The machines, as designed and flown, have been found to be unstable longitudinally in spite of having satisfactory tail volume coefficients, because the C.G. has not been so moved forward. It has been impossible to redesign the machine to correct the C.G., so that attempts have been made to improve the slope of the tail moment curve. An examination of the formula shows exactly how this is best done. Making a new tail of larger area but of the same span as the original is of no use because, although the area is increased, the slope of the tail lift curve, A_T, is reduced on account of the reduced aspect ratio (= span²/area). There may also be a backward movement of the C.G. due to the increased tail weight, which tends further to reduce the stability. Whatever modification is made, it must be such that the value of a_t and S_T are both improved and that the increase in tail weight does not seriously affect the C.G. movement.

The Cure

The suggested method of improving the stability is to increase the span of tail plane and, if possible, keep the chord the same (or less). A further improvement can be made by decreasing the chord of the elevators and increasing that of the fixed tail. This is not always possible and will have no effect if an irreversible control is fitted. The fitting of an irreversible control would very greatly improve matters, as this increases the slope of tail lift curve with control column free, but it must be remembered that such an apparatus must be so light or in such a position that it does not bring the C.G. back an appreciable amount which would vitiate the effect of the increased slope of the tail lift curve.

Another point which is emphasised by the formulae is that since the monoplane has probably a higher aspect ratio than the equivalent monoplane aspect ratio of the biplane, it has, therefore, a higher value for "a." This will, of course, necessitate either a further increase in the

"tail volume" or a forward movement of the C.G. to give stability.

This remark applies only where the same plan form of tail plane is fitted to each type. It will be noticed that the aspect ratio of the tail plane for a high-wing monoplane is not usually greater than that for a biplane. The high-wing monoplane and the biplane have their C.G. positions in approximately the same place with respect to the induced tangential force plane, although there is a very large variation of this dimension between an unstaggered equal-wing biplane and one having a large top plane together with pronounced stagger. The stability of the latter will be much better than that of the former, when the G.C. is situated at the same fraction of the mean lift plane.

From the above it will be seen that there is little to choose between the high-wing monoplane and a normal biplane, and both can be satisfactorily designed, using the tail volume formula.

With the Parasol arrangement it is to be expected that for the same tail volume the stability will be satisfactory at a further aft C.G. position than for any other of the types discussed. A flying boat of the biplane type, for instance, would be classed in this category. These aircraft would, however, have their onset of instability at high speeds, but would be very stable near the stall.

The Tail Volume Formula

This apparent checking up of our old friend the tail volume formula has naturally led designers to put so much faith in it that low-wing monoplanes have been designed by its use. The unsatisfactory stability characteristics of the low-wing monoplane at C.G. positions which would give satisfactory characteristics for a biplane or high-wing monoplane has come somewhat as a shock and there is a tendency for the blame to be laid on to some inherent peculiarity of the low-wing monoplane rather than on to the formula used for obtaining the tail size. Such a conclusion is premature and unjustified.

It will be shown in the following few paragraphs exactly how the C.G. of an aeroplane should vary with the position of the wing with respect to the C.G.

Assume tentatively that a certain high-wing monoplane is just stable with the C.G. at .36 of the mean chord when the vertical position of the C.G. is .2 chords below the mean induced tangential plane. Then the following table shows the relative position of the C.G. along the chord as the wing position is varied in the vertical plane. Equal stability is obtained in each case, when $K_L = .5$. (The same tail unit and tail arm are, of course, also assumed for each case—this is implied by the use of the tail volume formula.

Case.	Approximate Type (Monoplanes).	Vertical Position of C.G. Z with respect to mean induced tangential force plane.	Corresponding Horizontal C.G. Position ($X + \epsilon_m$) on the mean normal force plane for stability.
1	High-Wing Flying Boat ...	+ .3 or more	.396
2	High-Wing Landplane ...	+ .2 + .1	.36 .324
3	Medium Low-Wing with Dihedral	0	.289
4	Very Low-Wing. No Dihedral	− .1 (*i.e.*, C.G. is above induced tangential force plane).	.253

This clearly indicates the necessity of moving the C.G. forward as the wing is lowered with respect to the C.G. in order that the stability is not impaired. Case 4 would be very unstable at a C.G. position of .36 C.

It must be remembered in interpreting the above that Z, X and e are all in terms of the mean chord length and are given with respect to the Quarter Chord and No-lift angles.

The following gives the theoretical basis for equation (4), and detailed instructions of possible methods for determining the various constants.

(*a*) *Wing Moment about the C.G.*

The induced drag of a wing is given by

$$K_{D_i} = \left(\frac{1}{a_w} - \frac{1}{a_o}\right) K_L^2$$

since $K_L = a\alpha$ (where α is measured in radians from no-lift)

then $K_{D_i} = \left(a_w - \frac{a^2_w}{a_o}\right) \alpha^2$

The total drag is made up of $K_{D_i} + K_{D_p}$. The normal force coefficient K_n is given by

$$K_n = K_L \cos \alpha + K_D \sin \alpha.$$

Assuming α is small, $\cos \alpha = 1.0$ and $\sin \alpha = \alpha$, then $K_n = K_L + K_D\alpha$.

$$= K_L + \left(\frac{1}{a_w} - \frac{1}{a_o}\right) K_L^2 + K_{D_p}\alpha.$$

$$= K_L + K_L\alpha^2 - K_L^2 \frac{a}{a_o} + K_{D_p}\alpha.$$

$$= K_L \left(1 + \alpha^2 - K_L \frac{a}{a_o}\right) + K_{D_p}\alpha.$$

$$= K_L \left\{1 + \alpha^2 \left(1 - \frac{a_w}{a_o}\right)\right\} + K_{D_p}\alpha.$$

Since α^2 and $K_{D_p}\alpha$ are usually small compared with K_L, we may write

$$K_n \doteq K_L$$

The tangential force coefficient acting along the no-lift line is given by

$$K_T = - K_L \sin \alpha + K_D \cos \alpha.$$

which, when α is small, is given by

$$K_T = - K_L\alpha + K_D$$

$$= - K_L\alpha + \left(\frac{1}{a_w} - \frac{1}{a_o}\right) K_L^2 + K_{D_p}$$

$$= - \frac{K_L^2}{a_o} + K_{D_p}$$

The moment of the wings about the C.G. is then

$$K_{M_w} = K_{m_o} + K_nX + K_iZ$$

$$\doteq K_{m_o} + XK_L - \frac{ZK_L^2}{a_o} + Z.K_{D_p}$$

$$= K_{m_o} + Xa_w\alpha - \frac{Za^2_w}{a_o}\alpha^2 + ZK_{D_p} \quad .. \quad (5)$$

If it is assumed that K_{D_p} does not vary with incidence, then

$$\frac{dK_{M_w}}{d\alpha} = Xa_w - \frac{2Za^2_w}{a_o}\alpha$$

$$= a_w \left(X - \frac{2a_w}{a_o} Z\alpha\right)$$

Substituting K_L for $a_w\alpha$ gives

$$\frac{dK_{M_w}}{d\alpha} = a_w \left(X - \frac{2}{a_o} Z K_L\right)$$

Again substituting 2.82 as a mean value of a_o

$$\frac{dK_{M_w}}{d\alpha} = a_w (X - .71 Z.K_L)$$

which at $K_L = .5$ is

$$\frac{dK_M}{d\alpha} = a_w (X - .355 Z) \quad .. \quad .. \quad .. \quad (6)$$

(b) *Moment Produced by Tail Plane.*

The effective incidence of the tail plane =
$$\alpha + \eta_t - \beta = \alpha(1 - b) + \eta.$$
where η_t is the zero lift angle of the tail plane.

The lift coefficient produced by the tail is
$$K_v = a_t\{\alpha(1 - b) + \eta_t\}$$

Following similar arguments to those used for the wing it follows that

$$K_{MT} = \frac{S_T}{S_w} a_t \left\{ \alpha(1 - b) + \eta_t \right\} L + \frac{h a_t^2}{a_o} \left\{ \alpha(1 - b) + \eta_t \right\}^2 + hK_{D_p}$$

It will be noted that with floating elevators η_t is not a constant. For the purpose of this article the assumption is made that η_t is zero for all cases. Generally this is permissible since this angle is usually small. It, therefore, follows that

$$\frac{dK_{MT}}{da} = \frac{S_T}{S_w} a_t (1 - b) L + \frac{h a_t^2}{a_o} \left\{ 2\alpha(1 - b) \right\}$$
$$= \frac{S_T}{S_w} a_t (1 - b) \left(L + \frac{2h a_t}{a_o} \alpha \right)$$

Substituting for $a_o = 2.86$ and $\alpha = \frac{K_L}{a}$ we get

$$\frac{dK_{MT}}{da} = \frac{S_T}{S_w} a_t (1 - b) \left(L + \frac{h.a_t}{1.43.a} K_L \right)$$

Again at $K_L = .5$

$$\frac{dK_{MT}}{da} = \frac{S_T}{S_w} a_t (1 - b) \left(L + \frac{h.a_t}{2.86\ a} \right) \quad .. \quad .. \quad (7)$$

The Normal Force Plane—Biplanes and Monoplanes

Where the upper and lower wings have sweepback and/or dihedral, the mean plane for each is first determined and g and h^1 measured with respect to these mean planes. Unless the sweepback or dihedral of a parallel chord wing is excessive it will generally be sufficiently accurate to use the geometric mean for the two planes. Where a tapered wing is used, or the departure from a flat plane is excessive, the mean plane position must be determined from consideration of the spanwise loading, as follows :—

$$\bar{x}_n = \frac{\int_o^1 w\, x\, dy}{\int_o^1 w\, dy}$$

and $$\bar{z}_n = \frac{\int_o^1 w\, z\, dy}{\int_o^1 w\, dy}$$

where $w = K_L \frac{C}{\bar{C}}$ – the load grading curve (which in the case of a biplane may be assumed to be as given for a monoplane wing of the same plan form)

y = distance out from root in terms of span = 1

x = distance back of e_1C_1 from e_oC_o of root section measured along the no-lift line

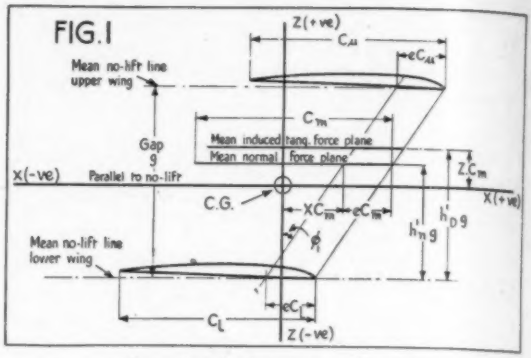
z = height of e_1C_1 of section above that of root section measured normal to no-lift line

$e = .25 - .4t^2$ (see. Ref. 3).

Letting the ratio of slopes of the lift curves of upper and lower planes be expressed as—

$$m = dK_{Lu}/da \div dK_{LL}/da = \frac{a_u}{a_L} \quad .. \quad .. \quad .. \quad (8)$$

and also
$$a_w S_w\, q = q\,(a_u S_u + a_L S_L)$$
where S_u and S_L = area of top and bottom planes respectively



S_w = total wing area = $S_u + S_L$

$q = \sigma\, \rho\, V^2$

Taking moments about the mean bottom plane

$a_u S_u g = a_w S_w (h^1 g)$

where g = gap measured normal to no-lift planes of upper and lower wings

$h^1 g$ = height of the mean " lift " plane above the mean bottom plane. (See Fig. 1.)

By substitution we have

$$h^1_n = \frac{m\, S_u}{mS_u + S_L} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (9)$$

It is assumed that the aerodynamic centres (e.C.) of the mean plane lies in the same plane as the aerodynamic centre of upper and lower wing.

Assuming the no-lift moment to be the same for top and bottom wings then the length of the AMC may be taken as that chord which, when associated with the same Km, and the total wing area, produces the same moment as the sum of the moments due to top and bottom wings thus

$q\, Km_o\, (S_u C_u + S_L C_L) = Km_o\, S\, q\, C_m$

where C_u and C_L are chords of top and bottom wing respectively

so that $$C_m = \frac{S_u C_u + S_L C_L}{S_w} \quad .. \quad .. \quad .. \quad .. \quad (10)$$

Where the Km_o of the wings vary, the same relationship for the mean chord is used, but the value of the mean Km, now becomes

$$Km_{om}\, C_m S = Km_{ou} C_u S_u + Km_{oL} C_L S_L$$
$$Km_{om} = \frac{Km_{ou} C_u S_u + Km_{oL} C_L S_L}{S_w C_m}$$

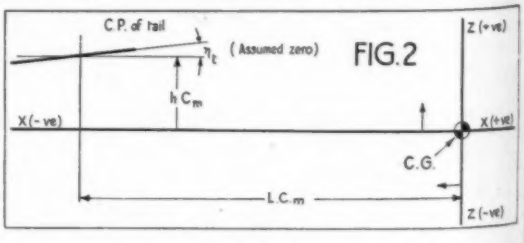
which on substitution for C_m from (9) gives

$$Km_{om} = \frac{Km_{ou} C_u S_u + Km_{oL} C_L S_L}{C_u S_u + C_L S_L} \quad .. \quad .. \quad (11)$$

The aerodynamic mean plane and the corresponding no-lift moment are then fully defined.

The Mean Tangential Force Plane

The mean tangential force can be split into two parts, one due to the profile drag and the other, which we will term " induced tangential force," due to K_L^2 (Equation 5). The former is of no interest to us as the profile drag



and the component of tangential force due to profile drag may be assumed sensibly constant with incidence. Therefore, the differential coefficient, $d\mathrm{K}_{\mathrm{D}_{pn}}/da$, is zero, where $\mathrm{K}_{\mathrm{D}_{pn}}$ is the component of the profile drag along the zero lift line.

The computations for the determination of the mean "Induced tangential plane" follow similar lines to those for the determination of the mean lift plane, except that for individual wings

$$\bar{z}_{\mathrm{D}} = \frac{\int_0^1 \frac{w^2}{C} z_{\mathrm{D}}\, dy}{\int_0^1 \frac{w^2}{C}\, dy}$$

where z_{D} = height of "Quarter" chord e.C. of section above that of root section measured normal to no-lift line.

In the case of a biplane, $\bar{z}_o$ is determined for each wing and then the height of the mean plane is given by

$$h'_{\mathrm{D}g} = \frac{m^2 \mathrm{S}_u}{m^2 \mathrm{S}_u + \mathrm{S}_{\mathrm{L}}} \cdot g$$

above the bottom mean plane.

(To be continued.)

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TECHNICAL LITERATURE

ENGINEERING AERODYNAMICS*

WHILE the profession of engineering is likely to remain an art—and aircraft designing is no exception—there could be no clearer indication of the increasing importance of aerodynamical science than the current output of new works on the subject. Thus recently from America we have had a new text by Prof. Wood of Cornell, followed by a new edition of Warner's well-known treatise, both of which have been reviewed in these pages. From America also we have recently seen the completion of a collective six-volume treatment of the theoretical field, under Dr. Durand's direction. On the domestic hearth, Dr. Piercy of Queen Mary College is known to have an entirely new work in the press, and rumour promises us a complete revision of Bairstow's original text, published immediately after the war and now somewhat *démodé*. Altogether, the serious student of aerodynamics would seem to be in for a spot of mental indigestion sampling so many inviting dishes.

The latest addition to the list is a new edition of Diehl's original work, first published in 1928 and now completely rewritten from cover to cover and doubled in size. A vast amount of new research data from the world's laboratories has been made available since that time and the present volume incorporates and digests this for the practising engineer who, from the very nature of his job, has little time to correlate it for himself. Undoubtedly the author's official status during many years in the U.S. Navy Bureau of Aeronautics and on the N.A.C.A., places him in an unusually advantageous position to maintain a working liaison between the scientist and the designer. Thus, we find that essential conclusions are presented in the form of straightforward equations or clear-cut charts from which the desired factors may be obtained directly for use in the design office. The busy engineer is not "detoured" by having to hunt down some elusive symbol, only to find that it is a function of some other hidden function. As the author himself states in Chapter 1: "If there is any ambiguity of meaning the symbol loses its value entirely and becomes an unqualified nuisance."

Chapter 2 contains a skeleton outline of Fluid Dynamics before leading up to the more practical applications of modern Wing Theory which follow in Chapter 3. And here one notes the perpetuation of an omission carried over from the earlier work. In view of Lanchester's classic volumes of 1907-08, this reviewer feels bound to question the author's statement on p. 31 that to Dr. Prandtl, in 1911, is due the basic concept of the vortex theory and the calculation of induced drag. Perhaps the argument has become a little vexatious with repetition, but from the published evidence it is clear that Lanchester laid down the fundamental concepts upon which Prandtl and his Göttingen school erected the mathematical edifice as we know it to-day. Such familiar names as Kutta, Joukowski, Glauert and Munk are each acknowledged in turn, but Lanchester not at all!

The interpretation of Wind-Tunnel Tests from the designer's angle is well presented in Chapter 4, where some of the author's statements will be encouraging to those who pin their faith to model testing, despite the scepticism which still smoulders in some quarters. The author believes that model tests carefully made and properly interpreted are thoroughly reliable, although he rightly emphasises that the accuracy of the final results will depend on a methodical system of check and recheck of such things as wind speed, balance alignment, tare readings, model setting and so on. In the proper interpretation of test data, the three important modifying effects of scale, wall interference and airstream turbulence are clearly described, and this reviewer, at any rate, has always felt grateful for Diehl's graphical treatment of Reynolds Number, neatly charted for the designer in Fig. 34.

Chapter 5 on Airfoil Data is an excellent summary of high-scale research, covering such subjects as scale effects, camber and thickness variation, wing section criteria, surface effects, interference, compressibility, etc. Some designers, however, may question the tabulation of profile drags on p. 115, stripped of their corresponding angles of incidence, especially if copies of the original N.A.C.A. reports are not on file. (The answer to that, of course, is that they should be!) But a more grievous omission is the author's tactful side-stepping of tapered wing idiosyncrasies now vexing the minds of workers in this country. Indeed, with the exception of reference to an isolated N.A.C.A. test of 1934, the tapered sections now in common usage are mostly ignored, which is surprising seeing that American constructors have pioneered the commercial exploitation of the cantilever monoplane. Apart from N.A.C.A. research itself, a great deal of moderately high-scale commercial testing of tapered wings has been conducted at the California Institute of Technology for such famous West Coast firms as Douglas, Northrop, Lockheed, Vultee, etc., so there can be no dearth of useful data awaiting the author's analytical microscope.

Load Distribution

While discussing the subject of aerofoils, an apparent gap in most texts on aerodynamics needs bridging at this point and Diehl's book is no exception to the rest. This concerns the study of air load distribution over wings and control surfaces required as a basis for structural design. Actually, a great deal of experimental work has been done to find a rational basis for such determination, but the structural textbooks appear to avoid this "no-man's land" between aerodynamics and structures. Even Prof. Younger in his recent structural text skips lightly over the hurdle by telling the enquiring student that "this field of study is one which properly belongs to books on aerodynamics rather than to those on structures." So one ventures to suggest that writers on aerodynamics might devote some of their attention to filling in the ditch between the adjoining fields.

Wing Flaps and High-Lift Devices, as befits their present importance in design technique, rate a special chapter to themselves. Eight distinct methods of increasing lift are described and charted. Six of these incorporate the various forms of flap in common use such as the plain split type, Zap, Junkers,

* By Lieut.-Cmdr. W. S. Diehl, U.S.N. 556 pp., 266 figs. The Ronald Press Co., New York. Price $7.00 (30s.).

Fowler and Handley Page slot-cum-flap arrangement, while the other two methods are boundary layer control and the Flettner rotor principle. The author brings out the significant features of each type and weighs their respective merits and demerits, although in the case of the Handley Page combination one believes that his figures are distinctly on the pessimistic side when judged by full-scale evidence on tapered monoplane wings.

The next two chapters cover the problems of Static and Dynamic Stability, the former being an extension of the author's original treatment of Control Surface Design, while the latter is an entirely new attempt to interest designers in a much more difficult subject. Unfortunately, in the past, dynamic stability has been in the hands of the professional mathematician with absolutely no conception of the designer's outlook, so the present outline, coming from a man of Diehl's practical turn of mind will be welcomed. These two chapters are about the best in the book, for the author is gifted with the happy knack of producing just that kind of quantitative result for which the designer is looking. The powerful influence of dihedral on lateral stability is particularly stressed, although the author does not mention the important effects of plan form, such as sweep-back and sweep-forward, in the case of tapered wings.

After a valuable collection of factual data on the Parasite Drag of Components in Chapter 9, most of the following chapters deal with some aspect of performance and its prediction. Thus in Chapter 10 the student obtains a "first-class" bearing on the subject by way of an excellent analysis of Engine and Propeller Considerations, including the effects of supercharging and propeller pitch control. This chapter, again, is just one more example of the author's gift for graphic signposting in the language of the engineer. Other chapters include the Calculation of Power Curves, Performance Estimation, Range and Endurance, Flight Testing and many other special problems of performance analysis and design. There is also a separate chapter on Seaplanes and Flying Boats, which looks a little out of place in an aerodynamics text, but which will undoubtedly be found handy by those interested in seaplane performance and tank testing.

This book is precisely what its title signifies—aerodynamics presented in a practical engineering fashion—and because the birth of any new aircraft type is pre-eminently an aerodynamic problem it merits the attention of designers as well as technicians. It goes without saying that it will be welcomed in this country by those who are familiar with the author's work through many excellent N.A.C.A. reports. Indeed, the name of Walter Diehl has come to mean something approaching perfection in the art of presenting scientific data in a palatable form to the engineer. So much so, that this reviewer has on more than one occasion been so unkind as to suggest that Diehl's technical reports might be taken as a model by those members of our own Research Committee entrusted with the editing and format of R. and M.s. Judging, however, from the latest official dress in which these are now appearing, that august body is surely beyond the help of mortal man or friendly critic, so one must bow before such majestic indifference and be thankful for the New Diehl.

S. H. E.

SUMMARIES OF A.R.C. REPORTS

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THE PERFORMANCE AND LONGITUDINAL STABILITY OF A SINGLE-ENGINED HIGH WING MONOPLANE. EXPERIMENTS ON A QUARTER SCALE MODEL WITH AIRSCREW RUNNING. By L. W. Bryant, A.R.C.Sc., D. H. Williams, B.Sc., and A. F. Brown, B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1687. (31 pages and 43 diagrams.) May 14, 1935. Price 3s. 6d. net.

The present report deals mainly with experiments on a quarter scale model of the Puss Moth in the Duplex wind tunnel, a repetition, with some additions, of the work carried out on the fifth scale model of the Bristol Fighter and described in R. & M.s 876 and 937. There are also included some measurements of lift, drag, and pitching moment of the tenth scale model in the 7 ft. No. 3 tunnel; these cover a range of negative angles of incidence from −10 deg. as well as the usual positive range up to about 20 deg. incidence. The Puss Moth shows some longitudinal instability at high speed and when diving and the cause of this has been examined in the course of the experiments on the larger model; the instability is due to a low position of the C.G. relative to the mean wing chord.

The top speed and maximum rate of climb agree reasonably well with the published full-scale figures of performance; the corrections to drag for Reynolds number and for surface roughness are probably of opposite sign. The total lift on the whole model without tailplane and with no airscrew is not far from that on the wings with the body replaced by a centre portion of wing surface with chord that at the wing roots.

The slope of the pitching moment curve due to the wings is considerably less stable at small positive and all negative angles than at larger positive angles. Since the pitching moment due to the tail is linear with incidence, the resultant pitching moment for the whole aircraft shows an important loss of stability at low angles of incidence. Some care in choice of position of the C.G. is therefore necessary if stick forces in a dive are not to be unduly heavy, or the handling at high speeds in gusty weather is not to be unduly difficult. These changes in stability at low angles of incidence are compared with the properties of several other machines which have been tested as models. Two high wing monoplanes with deep bodies tested at Ottawa show a similar property. The increased stable slope of the pitching moment curve for the wings can be wholly explained by the low position of the C.G. relative to the wings; the mutual interference between the wings and body increases the negative value of c_{mo}.

The slope of the curve of total downwash due to the slipstream plotted against angle of incidence of the wings may be calculated from the slope of the curve of downwash without slipstream by a formula which fits three different sets of model results for single-engined tractors.

Such full-scale data as are available for the trim and stability of the Puss Moth are not quantitatively accurate enough for a satisfactory comparison with the results of model tests. As regards stability, judged by C_m curves with free elevators, the model appears to be slightly more stable than the actual aeroplane for the same position of the C.G.

THE EFFECT OF CENTRAL CUTAWAY IN SPLIT FLAPS ON THE TRIM OF A LOW WING MONOPLANE. D. W. Bottle, B.Sc., A.C.G.I., C. Callen and K. W. Kirkby. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1701. (19 pages and 15 diagrams.) September 27, 1935. Price 3s. net.

Full scale tests on a number of aircraft with split flaps have indicated that there may be a considerable change in trim when the flaps are brought into operation. Whether the aircraft may become nose or tail heavy on lowering the flaps will depend on the following factors: the change in position of the centre of pressure of the wing, the reduction in the incidence of the aircraft, the change in downwash at the tail, and the procedure of the pilot when bringing the flaps into operation. In the subsequent analysis of the results two procedures which the pilot might adopt when lowering the flaps on coming in to land will be examined; first, when the speed and hence C_L is kept constant, and secondly when the same percentage margin of speed above stalling speed is maintained. Further, the change in trim due to lowering the flaps without altering the incidence of the model will be considered.

The investigation has been made on a 15 per cent. Schrenk flap at 60°. The change in position of the centre of pressure, the change in downwash at the tail, and the change in tail setting to trim, due to bringing the flaps into operation, have been measured for flaps of different amounts of central cutaway. Tests were made with the tailplane in two positions. Lift and drag curves were also obtained.

The reduction in lift due to central cutaway in the split flaps is not as large as results obtained on a wing alone would indicate. Central cutaway in the flaps makes the model more nose heavy. The change in trim due to central cutaway is not large, as the effect on incidence and downwash is nearly balanced by the change of the centre of pressure.

THE USE OF DYNAMICALLY SIMILAR MODELS FOR DETERMINING THE PORPOISING CHARACTERISTICS OF SEAPLANES. By L. P. Coombes, B.Sc., W. G. A. Perring, R.N.C., and L. Johnston, B.Sc. R. & M. No. 1718. (14 pages and 9 diagrams.) November, 1935. Price 2s. 6d. net.

The problem of porpoising has been considered theoretically in R. & M. 1403, and in two other reports, the stability characteristics of flying boats have been determined by calculations based upon derivatives obtained from model tank data.

Porpoising can also be investigated in a testing tank by studying the behaviour of models dynamically similar to the full scale aircraft. Preliminary experiments to develop this method of experimentation were made early in 1933, since when the stability characteristics of a number of new designs have been investigated. As no description of this work has yet been published, this report has been written to describe the method in use at the R.A.E. tank for testing dynamic models of seaplanes.

A dynamic model costs about £70 and takes about eight man-weeks to construct. To offset this, the testing is simpler, and, with large scale models, is safer than the corresponding tests of a normal model without air structure.

It is found, also, that tests of a bare model hull are not a reliable indication of the behaviour of the full scale seaplane, and experience is necessary in interpreting the results. The simplicity and value of the dynamic model test therefore justify the time and expense of construction when the design is of importance.

It is possible that simpler models will be used, so that the time and expense of construction will be reduced.

THE EFFECT OF A REDUCTION OF AILERON TORSIONAL STIFFNESS ON THE FLUTTER OF A MODEL WING. By V. M. Falkner B.Sc., A.M.I.Mech.E., W. P. Jones, B.A., and C. Scruton, B.Sc., of the Aerodynamics Department, N.P.L. R. & M. No. 1722. (8 pages and 12 diagrams.) October 17, 1935. Price 1s. 3d. net.

The purpose of the tests was to find the qualitative influence of a reduction of aileron torsional stiffness on wing flutter. The wing used was the flexible model Puss Moth wing described in R. & M. 1699, but with certain modifications to the aileron and control system.

Critical flutter speeds were measured firstly with the aileron torsional stiffness roughly twice that corresponding to the full-scale Puss Moth aileron. The tests were repeated with the torsional stiffness reduced to about 40 per cent. For each value of the torsional stiffness the flutter speeds were obtained for a variety of mass loading conditions of the aileron and with several different mass balance systems fitted.

With ailerons of relatively low torsional stiffness, appreciable reduction of the critical speed can result from a reduction of the torsional stiffness. It is considered that the effects of a given percentage reduction of the stiffness will be much less marked in the case of torsionally stiff ailerons.

The results of the tests suggest that if the model Puss Moth aileron had been fully reduced in torsional stiffness, somewhat lower critical flutter speeds than those recorded in R. & M. 1699 would have been obtained.

Topics of the Day

Comfort

THE other day I was told by a man—who is, incidentally, very much wrapped up in the business of selling light aeroplanes and should, therefore, know what he is talking about—that cabin comfort was very much overrated as a selling point. His contention was that the average private owner knew that an aeroplane was largely a sporting conveyance and that, as a class, the owner is still contented to take the rough with the smooth. His sales experience showed that prospective purchasers were interested in price, performance, maintenance, flying qualities, luggage space, and, last of all, their personal comfort.

It may be so, but I suggest that the private aeroplane should, by now, be growing out of the "crate" stage and that the private owner will, year by year, demand more and more in the way of comfort and convenience. Most of us remember the light car of fifteen years ago. People paid staggeringly high prices for the pleasure of sitting in the open surrounded by levers, bits of string, insulating tape and assorted spanners. Now, even in the least expensive of cars, we expect everything that was, in those days, only obtainable in the thousand pound class.

Admittedly, this comparison of possibilities is not quite a fair one, since the private aeroplane (in this climate, anyway) may always be a means of relaxation rather than of serious transport, and the pilot can never become as matter-of-fact in his demands as the motorist, who just buys £200's-worth of economical travel for four people. Few private owners have the chance, or even the time, to make their aeroplanes pay for themselves, and, consequently, these remain as sporting conveyances—for use "as and when."

The Future

NEVERTHELESS, it has been explained *ad nauseum* that the illusive man-in-the-street will, when considering this flying business, expect to find that his comfort is at least as well catered for as it is in the case of his £130 car. So that, if ownership is to increase to a really useful extent, the manufacturers must do some window-dressing.

The question is whether the man-in-the-street (I apologise for this fearful expression, but there is no other) will ever be encouraged into the air in really large quantities. I doubt it—and if they are, then lots of the old hands will stay on the ground, both to save their own skins and because so much of the attraction of flying is concerned with its uniqueness. When (and if) the sky is full of "little men," it will be more fun, and certainly more original, to go for walking tours, or even to stay at home.

More and more of the youngsters of each generation will take kindly to flying, and will look forward to possible ownership in due course; but, unless there is a radical change in aircraft design, it will continue to be a pastime for men and women with reasonably good nerves, eyesight and judgment. Eighty per cent. of the ordinary people in present-day civilisation are a little too timid and sheep-like to take to any means of transport for which the penalties of misjudgment are so comparatively heavy. Let us hope that commercial air transport becomes so safe and reliable that this eighty per cent. will travel by air on their everyday business journeys even if they do not act as their own chauffeurs.

Most of us, in unguarded moments, confess to suffering fear, both in the air and on the road, but this fear is not such as to upset our judgment or to offset the enjoyment and sense of accomplishment which self-conducted aviation bestows. When (and if) everyone is flying, we shall lose that sense of accomplishment while retaining the enjoyment—so long as everyone is properly trained and obeys the rules. If the average pilot acted like some of the average motorists one meets in the course of a run, then the earth would be strewn with wrecks and the hospitals and morgues would be filled to overflowing.

Common Sense

DESPITE the good features of many of the new breed of ultra-lights, some of them have a poor climb and some of them are fitted with engines which have certainly not yet proved themselves.

Therefore, with due deference to all pilots and manufacturers who should know their jobs a good deal better than I do, I suggest that all test and demonstration flying should be carried out at large aerodromes where the approaches are good. One can always cope with a dead-stick landing, made immediately after the take-off, if the whole run of a large aerodrome has been used and if the surroundings, in any case, are reasonably free from houses, factories, churches, tall trees, high-tension pylons, and such-like obstructions.

Most of the little fellows glide and land quite slowly, so that an emergency landing on rough ground should do very little, if any, personal damage. Even with the best and most reliable of full-size aeroplanes I am distinctly uncomfortable during a take-off towards, for instance, a row of houses—however fragile these may be.

As I've said before, the future of the ultra-lightweight will largely depend on the paucity—or otherwise—of accidents occurring during the summer of 1937. It is only common sense to avoid the possibility of such accidents so far as is reasonably possible.

INDICATOR.

Private Flying

FROM the CLUBS and SCHOOLS

LONDON

NEW members to join the London Aeroplane Club last week were Messrs. D. Cowan, A. L. Cundy, L. J. Blow and J. H. Wingate-Hill. The Club fleet put in 56 hr. 5 min. flying.

MIDLAND

Flying times for last week were: dual, 2 hr. 15 min., solo, 8 hr. 55min. Cross-country flights were made to Croydon, Hatfield and Heston.

C. A. S. C.

Last week-end members flew 9 hr. 20 min. at Cambridge, Mr. G. Gardiner making his first solo flight. On Sunday, April 4, the Corps will hold an open day at Fen Ditton aerodrome, when members of all Squadrons are invited to attend with their friends.

CAMBRIDGE

Flying times at Marshalls' Flying School for the week ended March 14 totalled 34 hr. 45 min. Two members flew the Puss Moth to the Cheltenham Races. Messrs. Humphrey, Brown and Maitland have joined the School.

YORKSHIRE

Club machines flew 10 hr. 15 min. last week, flying being possible on two days only. Trips were made over Ely and Fenland, to Stamford Bridge and South Yorkshire, and to Liverpool and back. The time flown in February was 46 hr. 35 min.

LEEMING

Time for the week ended March 20 totalled 24 hr. 10 min. New members are Messrs. English and Myler. Visitors during the week included Sqn. Ldr. Atcherley in his Comper Swift and Mr. R. Malone in a Monospar. The Club will shortly take delivery of its new Miles Magister trainer.

SOUTH COAST

The Club will be open as usual all through the Easter holidays. Flying time for last week amounted to 35 hours, while Mr. R. W. Wright has passed the tests for his "A" licence. Miss Spiller and Messrs. Stevens and Reed have started a blind-flying course in preparation for their "B" licence tests.

NORFOLK AND NORWICH

As the evenings lengthen so the Club's flying hours increase, and last week over forty hours were recorded. The addition to the fleet of a Gipsy II Moth will help considerably to increase this figure. The Club will be open during the whole of the Easter holidays. Flying will not be possible on the Tuesday and Wednesday following the holiday, but the clubhouse and aerodrome will be open for visitors by air.

BROOKLANDS

Seventy-five hours were flown during the week, this being twenty-five up on the weekly averages of recent times. Major Shearer and Mr. J. V. Cain have passed the final "A" licence tests, and Flt. Lt. Grey has completed the blind-flying course. New members are Messrs. Piekar, Larby, Botting, Barnett and Desmond Fitzgerald. Mrs. Riggell has returned to Brooklands with the object of renewing her licence. Her daughter is also taking instruction. The rebuilt hangars are now almost complete.

HANWORTH

Forty-four hours' flying was logged during the week ended March 20. New members are Messrs. Prytherch, B. D. Lock and S. Tait. Mr. F. W. Broughton has passed his "A" licence tests. Several machines were hired by members for the Lincoln and Grand National. The Aeroncas are still kept very busy, and Count Arco, of the German Air Force, has been making good use of one. A large number of members attended the Carnival Ball held by the Club at Hanworth Park Hotel on March 17.

KARACHI

During February members of the Karachi Aero Club flew 185 hr. 45 min., of which 3 hr. 45 min. were spent in night flying. The advanced training of pilots for "B" licences is steadily growing in importance and pupils are being attracted from all over India. With the recent addition of another metal Moth, the Club now has at its disposal a fleet of six machines—four D.H. Moths, one Leopard Moth and one Hornet Moth; two of them are fitted for night- and instrument-flying. Nine apprentices are receiving technical tuition as ground engineers.

LANCASHIRE

Flying at Woodford is still being affected by adverse weather conditions, and members have had considerable experience of bad weather during the last few weeks. Three glider pilots, Messrs. Robertson, Slater and Smith, of the Lancashire and Derbyshire Gliding Club, are undergoing instrument-flying courses prior to attending the International Glider Competitions in Germany next July. Mr. P. W. Fell is taking an instructor's course. New members include Mr. and Mrs. Denton and Messrs. Robertson, Slater and Smith.

REDHILL

The total flying time at Redhill aerodrome for the week ended March 19 was 54 hr. 55 min. During this period the Hillson Praga was demonstrated and four new members joined the Club. Good Friday will be the only day on which the Club will be closed for the Easter holidays.

SOUTHEND

During last week there was a marked increase in the flying times. Saturday and Sunday were the two busiest days of the year, and all the machines were fully engaged throughout the day. During Sunday Mr. Willows arrived from Paris on his return from Egypt. Customs facilities were available and he left shortly after for Heston. Several new members have joined the Club to take their "A" licences. On Easter Saturday and Monday dances are being held in the clubhouse. All visitors and members are welcome.

BOMBAY

The Bombay Flying Club put in 251 hr. 15 min. flying during the month of February, which is a new record for the year. Cross-country flights were made to Colombo, Indore, Poona, Udaipur, Hyderabad and Jamnagar. The Club was turned into a temporary studio for the Wadia Movietone company to shoot a few scenes for a forthcoming production. Six members have renewed their "A" licences and Messrs. D. A. Samant and K. B. Commissariat have gone solo.

CINQUE PORTS

Three new members to join the Club during last week, chiefly as a result of the annual dinner and dance, were Miss Zora and Mr. and Mrs. Tilley. The Club's new Tiger Moth is now out of the workshops and has started work. This machine is a very necessary addition in view of the number of new "B" licence aspirants. On Saturday Mr. E. T. Symmons (whose name, we regret to say, was incorrectly spelt in last week's issue.—Ed.), together with Mr. Kane, took the Club's Leopard to Paris, returning on Sunday. He had a spot of bother at Berck, where both the machine (and an extrication lorry) got well and truly bogged. Amongst visitors to the Club during the week was Mr. O. V. Holmes, in his Cessna, which is fitted up with two-way radio and some incredible gadgets for testing parachutes. On Friday Flt. Lt. Wilkinson took the Monospar with a party of three to Salzburg. Several members attended the Grand National, Mr. W. T. Pitt taking the new Cirrus-Swallow, and a party of seven going with Bill Ledlie in a Rapide.

Mayoral Aviation

IN the matter of a flight made in the "King's Cup and Cape Record" Falcon by the Lord Mayor of Leicester, reported last week, it should be pointed out that the pilot was Mr. J. C. V. K. Watson, of Germ Oils, Ltd., who recently acquired the machine.

A Continental Tour from Carlisle

THE Border Flying Club is hoping to organise a Continental tour some time in July of this year. No definite route has been selected, and the final choice will be left to those taking part. The tour will, however, be run at as low a cost as possible, and will not include too much flying. Members of the Club will, of course, have preference, but anyone who wishes to take part may apply.

Heston Farewell

THE majority of people who visit Heston in the course of business or of pleasure will, while welcoming the new Airwork Press Secretary, Mr. Shaw, regret the departure of Miss Mary de Bunsen.

Apart from her efforts in the production of the Heston news bulletin—an entertaining and informative affair—Miss de Bunsen has always been a tremendous help when special information was required. In fact, on the occasion of the Week-End Aerien, last year, she appeared to be the only person, not excluding Aero Club officials, who knew which visitors had arrived, when, and with what.

Super-Ownership

THE number of comparatively large machines owned and operated either by private individuals or business concerns throughout the world always comes as a surprise to those who complain of the relatively few private owners to be found. Amongst larger machines there are three privately owned Airspeed Envoys. The first is the Maharajah of Jaipur's, the second was supplied to the managing director of a large Czechoslovakian steel corporation, and the third will shortly be delivered to the Maharajah. A fourth, and much more interesting, privately owned Envoy will shortly appear.

LARGEST AIR ESTIMATES EVER

Points From Sir Philip Sassoon's Speech in the House

"IT is my duty this afternoon to introduce the largest air estimates which have ever been presented to this house. The net estimate of £82,500,000, including loan provision, compares with an average figure of some £18,000,000 asked for by the Ministry in pre-expansion years. It shows an increase of nearly £32,000 on the total estimates of 1936. The magnitude of this figure gives rise to mingled feelings of disappointment and relief. All must regret the necessity to expend so vast a sum on military preparation. Yet all must feel relief that proper steps are being taken to safeguard our own country against attack and to fulfil our international obligations."

Thus Sir Philip Sassoon, introducing the air estimates in the House of Commons last week. From this striking opening, Sir Philip went on to say that in previous years he had been careful to point out that our expansion in no way meant that we had abandoned our hope of securing an air pact and a general stabilisation of air armaments. Neither had we abandoned that hope to-day. On the contrary, the Government regarded its realisation as a matter of paramount importance. They would seize instantly every opportunity to achieve it. Until such opportunity offered, however, they had no choice but to proceed with their plans. Indeed, they believed that a British Air Force strong, ready and well equipped was one of the greatest contributions which this country could make to the peace of the world.

Sir Philip then proceeded to describe the progress of the expansion: "Two fundamental considerations," he said, have always been present in our minds. Is our programme adequate, and is it being carried out in the most effective way? As regards adequacy, I can only remind the House that the Government has many sources of information open to it. Many of these are sources which, in the nature of things, cannot be available to private individuals. The information from all these sources is correlated, and it is upon this information that the programme must be based. The House will not expect me to disclose the sources from which our information is derived, but it is entitled to the assurance that all the information that reaches the Government is constantly under the review of the Committee of Imperial Defence and the Government, and the programme is based on that knowledge.

Among the points dealt with by Sir Philip Sassoon were :—

First-rate quality and quantity in R.A.F. recruiting.

Browning and new Vickers guns introduced.

Research into high-efficiency fuels.

Sleeve-valve engine developments.

Aircraft production delays. (*An article on this subject appears on p. 300.*)

Shortage of skilled employees.

Ordering "off the board."

The Air Ministry and the contractors.

Three Main Problems

"With regard to the second consideration, in any defence programme there are three main problems which have to be dealt with—men, material and the war potential. I should here emphasise that the Air Force expansion is not merely a question of making good deficiencies. It means practically the trebling of a force as well as re-arming it with modern equipment.

"It will be convenient if I deal with the problems in the order I have stated. I deliberately start with personnel, as the importance of this aspect of our expansion cannot be overemphasised. An ample supply and reserve of really skilled personnel are not only important, they are essential. After all, aircraft and aero engines can be produced with increasing speed as experience of production is gained and as new plant comes into operation. It is a mechanical problem. It is a problem of production. Not so with personnel. Training cannot be improvised. A considerable period is absolutely necessary to train really skilled pilots, navigators, and so forth."

Sir Philip assured the House that the recruiting of pilots and ground personnel had been entirely satisfactory, and added that the education and character of those selected was first-rate. He also dealt with the Air Ministry's efforts to secure employment for officers and airmen on leaving the service. He described the arrangement for the attachment of Dominion cadets with the R.A.F., and also outlined the scheme for the R.A.F. Volunteer Reserve, which has been fully dealt with in *Flight*.

After dealing with the problems of finding sites for new aerodromes, Sir Philip admitted that during recent months, unfortunately, building labour had become more and more difficult to obtain. He confessed that that was causing some embarrassment. Unless a satisfactory solution could be found, it must entail delays in the building programme.

He then turned to the second of the expansion problems—that of the production of adequate supplies of equipment. He dilated on the excellence of British designs and referred to the change over to the monoplane and the improved performance of our aircraft. "The net result is," he said, "that the striking power of our new types far surpasses that of corresponding types of two years ago. Let me emphasise, however, that we are far from resting content with the design of our new machines. Active research and development are continually in progress with a view to obtaining machines of even greater speed, range and load capacity.

"While I am dealing with our progress on these lines, I may, perhaps, refer shortly to advances we have made in certain other directions. In particular, two new guns have been introduced for use on aircraft. One is a completely new type of Vickers gun. The other is the Browning gun, which has the merit of simplicity and gives a greatly improved performance for aerial use. Arrangements have been made for its manufacture in this country.

"Active research continues to exploit still further the advantages of higher quality fuel. Tests of the sleeve-valve aero engine, which gives substantial reduction in maintenance as well as more rapid production and a better performance, have been most encouraging, and it is about to go for service trials."

Airframe Delays

Turning to the Air Ministry's relations with contractors, Sir Philip went on: "As regards delivery of aircraft, we have stated frankly that there have been delays, and naturally we have been disappointed. Let me remind the House that deliveries for our programme have been based on the forecasts of manufacturers. These forecasts were necessarily framed on inadequate experience of production difficulties with the most modern designs of aircraft and have inevitably proved in many cases optimistic, so that firms have not been able to keep up to schedule. . . . The delays have been due to various causes. First there have been difficulties of skilled labour. There has been a shortage—a distinct shortage—of skilled draughtsmen. Again, firms had little post-war experience of large-scale production. They had to extend their shops, re-arrange their layout, reorganise their whole system. All this had to take place concurrently with the maximum production from their existing plant.

"Thirdly, the large increase in demand coincided with a most remarkable advance in aeronautical design and technique. The Air Ministry took the risk—a deliberate risk—of placing production orders for new types before their prototypes had been built and tested. Under this latter policy it was inevitable that some of the teething troubles usually associated with the prototype should manifest themselves in the first production machines. The necessity for simultaneous development of quite new quantity production methods has also tended to cause delay. These difficulties are, however, steadily being overcome.

"None the less, the new method is proving incomparably quicker than the old. We have, in fact, more than halved the time taken in bringing a new machine into production. Deliveries of the new types are now commencing and the rate of output is being increased progressively. The risk we have taken has proved to be thoroughly justified and a thousand times worth while."

Sir Philip then explained that it would not be desirable to entrust the production of complete aircraft to firms without experience of that work, and likewise that to draft picked men

from other engineering trades would dislocate the general engineering industry. He then turned to the subject of contracts and said: "The Air Ministry has had three objects constantly in view. First, to get the machines we want; second, to obtain them as quickly as possible; and third, to get them at a fair price. Many steps have been taken to achieve these ends. To obtain deliveries we have persuaded manufacturers to make large extensions of factories and plant. In doing this they were naturally anxious as to whether they might be left with redundant buildings and plant when expansion was completed. We want to avoid the experience of the last war, when firms who had energetically expanded buildings and plant were left with these on their hands. We therefore considered it right and proper to safeguard the manufacturers against similar risks by introducing a capital clause into contracts. In effect it provides that if on completion of expansion it is found that contractors are burdened with buildings and plant erected to carry out our contracts, for which they can no longer find employment, they will be able to claim compensation. Before compensation is awarded, however, the contractors' books will be fully and carefully inspected. If it is then found that, in spite of all precautions, excessive profit has been made in an isolated case, the excess profit will be taken into account in assessing the amount of compensation. This arrangement gives the contractor the security he needs, and ensures that the taxpayer pays no more than he should.

"I should now like to deal with the question of costs and prices. In the first place we have the fullest right of inspection of the books of contractors. Our own accounting and technical costings departments have been immensely strengthened, as the House knows. We further have the assistance of Mr. Reeve, managing director of the Associated Equipment Company, with his wide experience of costs in relation to engineering production.

"In many cases we are dealing with new types. Even the contractor does not know what his costs will be. We give, therefore, our 'instructions to proceed,' and then wait for a first, or it may be a second, small batch of machines to be manufactured. If sufficient information is then available, a fixed price is then agreed for the remainder of the contract. It may be, however, that even then we cannot be certain what is a fair price for the whole order. In such cases we agree what is called a 'basic price' on such information as we possess. If by increased efficiency the contractor delivers the bulk order at less than the basic price the saving is shared between him and the taxpayer. If the basic price is exceeded, the contractor will receive what he has actually spent; but his profits will be based not on the actual cost, but on the basic price. The contractor has every inducement, therefore, to produce as efficiently and cheaply as possible, and the undesirable features of time-and-line contracts are eliminated. Firms have a right to go to arbitration over the capital clause, and they have also that right on individual contracts. I am glad to pay tribute here to the invaluable assistance given to us by the Hardman Lever Committee, who are advisers on matters of principle and arbitrators in matters of dispute."

Sir Philip then turned to civil flying and outlined the Empire air scheme, the formation of the Air Registration Board, which he expected would commence operations within a few weeks under the chairmanship of Sir Maurice Denny, and the recommendations of the Maybury Committee, which, he said, had received the approval of H.M. Government. He concluded his speech: "I make bold to say that so large an expansion in so short a time is something which has not been approached, even remotely, under the like conditions by any other defence department. It is, indeed, an expansion without parallel in time of peace in the history of our country. It is being accomplished by voluntary effort, not by emergency powers. It is based on goodwill and co-operation, not upon dictatorial decrees. We have still an enormous task before us during the next two years. I venture to say that we have made a good beginning of an expansion scheme of which even yet we cannot clearly see the end. I am confident that, if the help and encouragement we have received during the past two years is continued, we shall surmount successfully whatever further problems we may be called upon to meet."

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for inclusion in these columns.

OUR OWN AIR WAR MUSEUM

CAPTAIN MACMILLAN, in his article entitled "Now—and Then," on page 204 of your issue of March 4, refers to the fact that we in Great Britain have not seen fit to preserve specimens of our war-time aircraft in the way that has been done in Germany.

Although there is no doubt that the Germans have preserved a greater number of types of war-time aircraft than we, it is not perhaps generally known in this country that records are preserved here in the Imperial War Museum of the majority of British and Allied war-time aircraft. These records are of two kinds; in the Museum itself there are exhibited actual specimens of five war-time aircraft, namely, a Sunbeam Short seaplane, an R.E.8, a Bristol Fighter, a B.E.2.C., and a Sopwith Camel. In addition to these there are scale models of a large number of similar types, while in the Photographic Records Section photographs are preserved of practically every type of aeroplane used during the war.

There are, of course, one or two gaps in this collection, but largely through the generosity and interest of visitors these are gradually being filled, and we should like to take this opportunity of drawing the attention of your readers to the fact that we are always pleased to see any private collections of war-time photographs that they may be in a position to lend to us for copying.

A. J. INSALL, Air Section,
Lambeth Road, London, E.C.1. Imperial War Museum.

SAILPLANE V. AEROPLANE

AFTER reading "Bellerophon's" article in last week's issue I looked up again with a sigh and an even greater admiration for sailplane pilots.

The sigh was caused by the realisation that these sailplane pilots *do* take criticisms so deeply to heart; they appear to imagine that all the ham-fisted power-pilots look on soaring as a valueless and absurd pastime. Even if this *were* so, they should be able to laugh it aside without turning a hair; after all, does it matter what the rest of the world thinks? My memory of a certain "gliding" evening at the Forum Club was one of continuous and acrimonious bickerment; the aloof and sarcastic attitude of the sailplane kings suggesting, to any amateur psycho-analyst, a mere inverted inferiority complex.

The increase in admiration came from the realisation that these kings flew such clean machines at such accurate airspeeds.

Nevertheless, I beg leave to doubt one contention by "Bellerophon." He says that sailplane experience has made him a safer and better pilot than he was four years ago as a power-pilot. So he should be, with forty-five more hours in his log-book—and on entirely different types—but I suggest that he is only a better *sailplane* pilot and that he would be pretty well lost for an hour or so in a noisy, brick-like and violent power-aeroplane.

This suggestion is supported by the recent experience of a friend of mine who took a sailplane expert up for dual in a trainer. Allowing (or not allowing) for cumulative exaggeration in the telling, it seems that no one less like a flying expert could have been imagined. His approaches were bad, his glide was a danger, and his landings were appalling. And why should we criticise him? Could an expert dinghy skipper take charge of a diesel-engined cargo vessel in a crowded estuary? PEGASUS.

London, W.1.

NO 27 SQUADRON'S SONG

NOT many months before the close of the War in 1918, No. 49 Squadron R.A.F., in which I was serving, was situated on an aerodrome adjoining that occupied by No. 27, and I was very impressed at the time with the squadron song as played by their Armament Officer and sung by members of the officers' mess.

The words of the chorus I remember:—

"Come to twenty-seven if you fly a D.H. nine,
For we don't talk any nonsense but we get there every time.
The C.O.'s name is Major Hill, he's perfectly sublime,
So come to twenty-seven if you want a d— good time."

—but cannot recall the verses, and I am wondering if any ex-member of No. 27 can furnish them. P. L. SMITH.

Watford, Herts.

[*Owing to pressure on space, a number of letters are unavoidably held over.—Ed.*]

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

SOCCER IN INDIA: No. 28 (A.C.) Sqn. Football XI which has been very successful in the Durand Competition at Simla, with the Abdul Gaffoor Shield and cups which they won.

NOMENCLATURE OF AERO ENGINE

The name of the new Bristol 9-cylinder sleeve valve air-cooled radial engine about to be introduced into the service for installation in the Vildebeest IV aeroplane is the Perseus VIII.

FLEET AIR ARM

The Admiralty have decided that officers transferred from the Royal Naval Reserve to the Supplementary List of the Royal Navy will be eligible to volunteer to specialise as observers in the Fleet Air Arm if under 28, instead of under 24 as originally announced.

FLYING ACCIDENT

The Air Ministry regrets to announce that Flt. Lt. Richard William Wicks lost his life as the result of an aircraft accident which occurred at Saxelby, near Melton Mowbray, on March 15. Flt. Lt. Wicks was the pilot and sole occupant of the aircraft.

FORMATION OF No. 4 (BOMBER) GROUP

No. 4 (Bomber) Group will form at Mildenhall on April 1, 1937, in the Bomber Command, and will take over executive command of the following stations, with the units at those stations, with effect from July 1, 1937: Dishforth, Driffield, Finningley, Leaconfield, and Linton-upon-Ouse. The new Group will move to Linton-upon-Ouse on a date which will be notified later.

ARMAMENT TRAINING CAMP

No. 6 Armament Training Camp will form at Woodsford, near Dorchester, on May 1, on which date the station will be placed under the command of the A.O.C.-in-C., Training Command, in the Armament Group. The aerodrome may be used with effect from April 1 for aircraft of personnel visiting the station on duty in connection with the opening, but no facilities of any kind will be available. The aerodrome will not be available for general use until June 1. The range at Chesil Bank will be available for use as from June 1.

BALUCHISTAN AIR PATROL

One flight of army co-operation aircraft is to be stationed at Fort Sandeman on the Baluchistan border to keep watch with the Army forces in the Zhob area.

The flight, which will be provided by No. 31 (Army Co-operation) Squadron, is to be kept at readiness for emergency work and will comply immediately with all calls for assistance. A care and maintenance party will be posted to Fort Sandeman. The Army force at the fort comprises one mountain battery, three Indian battalions, a signal section, and four transport units.

A CHANGE OF TITLE

The Directorate of Works and Buildings will in future be known as the "Directorate of Works." The Director will be known as the "Director of Works" (D.W.).

CHAPLAINS

The undermentioned chaplains have been selected for permanent commissions, subject to physical fitness: Revd. Thomas Madoc Jones, B.A., and Revd. Christopher Ridley Richardson.

NEW STATION HEADQUARTERS

A station headquarters will form at Honington, near Bury St. Edmund's, on May 3, on which date the station will be placed under the command of the A.O.C.-in-C., Bomber Command, in No. 3 (Bomber) Group.

The aerodrome may be used with effect from April 6, for aircraft of personnel visiting the station on duty in connection with the opening, but no facilities of any kind will be available. The aerodrome will not be available for general use until June 7.

AIR FORCE LIST

The March issue of the *Air Force List* has now been published. It can be purchased (price 3s.) from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh; 2, York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square, Belfast; or through any bookseller.

LEGION OF FRONTIERSMEN

Two years ago the Legion of Frontiersmen formed an Air Defence branch with the object of raising air squadrons for co-operation with units of the Territorial Army. There is no attempt to compete with existing Services, and before members are accepted they are questioned as to whether they are in a position to serve in either the regular or Territorial forces. The members are drawn from civilian and ex-R.A.F. pilots who are too old or are otherwise unable to join any existing Air Force formation. The branch is organised in three flights, located at York, Leeds, and Doncaster, and it has now almost reached squadron strength. Last year the branch co-operated several times with Territorial units in Yorkshire in tactical exercises, and arrangements are being made for simular activities this year. The uniform worn is blue. No grant is made by the Government and the members themselves bear the flying costs and purchase their own uniforms. This attempt to train in peace time a body of men who should be of service in a time of emergency deserves all praise, especially as the branch is not a mere flying club but tries to give flight training and squadron training.

STUDY OF FOREIGN LANGUAGES

Dutch has been added to the list of languages for which awards may be granted under R.A.F. regulations.

Examinations in Dutch will be held twice a year, and facilities for the study of the language abroad provided, under the conditions at present in force for French, German, Italian and Spanish. Awards varying from £12 10s. to £25 will be payable to officers who qualify in accordance with the regulations.

THE NAVAL REVIEW

The R.A.F. Yacht Club proposes to charter a steamer to enable officers and their guests to witness the Naval Review at Spithead on May 22. The price of tickets will be approximately 30s. each, including lunch, tea and supper. The vessel will accommodate about 300 people. Applications for tickets should be forwarded with the least possible delay to: The Honorary Secretary, R.A.F. Yacht Club, Fawley, Southampton.

ROYAL AIR FORCE GAZETTE

London Gazette, March 16, 1937

General Duties Branch

Flt. Lt. N. D. Crockart is granted a permanent commission in that rank (March 11).

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers (January 6):—G. L. C. Bagshaw, P. E. Bennett, G. R. Boles, C. H. Bull, R. W. Denison, J. R. L. Edminson, L. F. Gregory, R. P. A. Harrison, L. R. Helps, W. A. Howell, G. V. Lane, F. R. Maguire, A. G. Malan, R. E. Mills, I. G. Morrison, E. G. Palmer, D. Parker, P. R. Patrick, G. W. Prior, J. W. B. Richardson, F. M. Smith, G. G. Storey, D. M. Strong, W. P. F. Treacy, C. A. Turner, H. A. A. Webster, J. H. White.

Pilot Officer on probation P. G. Keeble is confirmed in his appointment (February 28).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—J. N. Tomes (February 24); G. J. Grindell (March 2).

Flt. Lt. D. W. Bayne is placed on the half-pay list, Scale A (February 20); Flt. Lt. G. R. A. Elsmie is placed on the half-pay list, Scale B, from March 1 to 5, inclusive; Lt. E. H. G. Stokes, R.N., Flying Officer R.A.F., ceases to be attached to the R.A.F. with effect from January 25 on return to Naval duty, and is reattached to the R.A.F. as a Flying Officer with effect from March 5 and with seniority of May 14, 1933; Flt. Lt. G. R. A. Elsmie is seconded for service as Aide-de-Camp to the Governor of Kenya (March 6).

The following Flight Lieutenants are transferred to the Reserve, Class A, on the dates stated:—W. J. Craig and W. McA. McAulay (March 11); H. V. Horner and R. J. Twamley (March 13); R. G. Wilde (March 14).

F/O. R. B. Middleton is transferred to the Reserve, Class A (March 16); Flt. Lt. P. E. Hudson resigns his permanent commission (March 5); the short-service commission of Acting Pilot Officer on probation J. M. Merry is terminated on cessation of duty (March 9).

ACCOUNTANT BRANCH

Sqn. Ldr. H. G. Bushell (since resigned) takes rank and precedence as if his appointment as Squadron Leader bore date February 18, 1936. Reduction takes effect from February 18, 1936.

COMMISSIONED PHOTOGRAPHY OFFICER

Flying Officer on probation F. C. Crowdy is confirmed in his appointment (January 6).

ROYAL AIR FORCE RESERVE

General Duties Branch

The following are granted commissions as Pilot Officers in Class AA (March 16):—C. J. D. Andreae, A. I. S. Debenham, P. W. F. Landale, W. J. M. Scott.

Engr. Cdr. W. A. Howsego (R.N., retired) is granted a commission as Flight Lieutenant in Class C (February 8); F/O. H. A. Boniface is granted a commission as Flight Lieutenant in Class C (January 27); Flt. Lt. R. S. Higgens is transferred from Class C to Class A (October 15, 1936).

The following Flying Officers relinquish their commissions on completion of service and are permitted to retain their rank:—E. A. Turnbull (December 5, 1936); F. J. Islip (February 8); P. E. G. Sayer (March 2).

Flt. Lt. B. H. Godfrey (Flight Lieutenant, R.A.F., retired) relinquishes his Reserve commission on completion of service (January 27).

SPECIAL RESERVE

General Duties Branch

The notification in the *Gazette* of February 2 concerning Charles Montgomery Beattie Archibald is cancelled.

AUXILIARY AIR FORCE

General Duties Branch

No. 500 (COUNTY OF KENT) (BOMBER) SQUADRON.—M. G. L. Foster is granted a commission as Pilot Officer (February 24).

No. 604 (COUNTY OF MIDDLESEX) (FIGHTER) SQUADRON.—P/O. E. N. Prescott is promoted to the rank of Flying Officer (November 29, 1936).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commander.—E. R. Openshaw, A.F.C., to Headquarters, Bomber Command, Uxbridge; for Armament duties, 20.2.37.

Squadron Leaders.—G. G. Banting, to Headquarters, Training Command, Market Drayton; for Air Staff duties, 2.3.37. N. H. D'Aeth, to Headquarters, Fighter Command, Stanmore; for Navigation duties, 8.3.37. S. M. Park, to Deputy Directorate of War Organisation, Air Ministry, 3.3.37. G. B. Beardsworth, to No. 36 (Torpedo Bomber) Squadron, Seletar, Straits Settlements; to command, 1.2.37. F. L. B. Hebbert, to R.A.F. Station, Catterick, 1.3.37; to command, 1.3.37. J. A. Boret, M.C., A.F.C., to Headquarters, No. 22 (Army Co-operation) Group, South Farnborough; for Air Staff duties, 4.3.37.

Flight Lieutenants.—C. M. Windsor, to Headquarters, R.A.F., Palestine and Transjordan, Palestine, 3.12.36. A. E. Louks, to R.A.F. Station, North Coates Fitties, 2.3.37. A. C. Weldon, to No. 26 (Army Co-operation) Squadron, Catterick, 11.2.37. D. D. Christie, to No. 61 (Bomber) Squadron, Hemswell, 8.3.37. J. N. T. Stephenson, to Superintendent of the Reserve, Hendon, 7.3.37. J. Mutch, to R.A.F. College, Cranwell, 8.3.37. T. H. L. Nicholls, to No. 63 (B) Squadron, Upwood, 15.2.37. G. R. A. Elsmie, to Special duty List; for duty as A.D.C. to the Governor of Kenya, 6.3.37. W. N. McKechnie, to No. 1 (Indian) Group Headquarters, Peshawar, India, 11.3.37.

Flying Officer.—C. H. D. Wardrop, to No. 57 (B) Squadron, Upper Heyford, 28.2.37.

Pilot Officers.—J. W. S. Fowler, L. V. James, to No. 63 (B) Squadron, Upwood, 15.2.37. J. F. H. Weston, to No. 5 (A.C.) Squadron, Chaklala, India, 11.3.37. J. C. Betts, J. H. D. Chapple, to No. 11 (B) Squadron, Risalpur, India, 11.3.37. J. A. W. Lawrence, B. J. Thomas, to No. 27 (B) Squadron, Kohat, India, 11.3.37. C. B. E. Burt-Andrews, I. A. Ferguson, to No. 28 (A.C.) Squadron, Ambala, India, 11.3.37. J. F. Grey, to No. 60 (B) Squadron, Kohat, India, 11.3.37. W. C. A. Church, to R.A.F. Depot, Uxbridge, 7.3.37. J. W. Allsop, P. C. Hughes, K. W. Kaufmann, C. R. Kelaher, L. L. Johnston and C. G. C. Olive, to No. 2 Flying Training School, Digby, 27.2.37. H. N. Fowler, G. E. Grey-Smith, W. Kinane, to No. 6 Flying Training School, Netheravon, 28.2.37. D. G. Boehm, D. A. Cameron, C. R. Mace, R. M. Power, to No. 11 Flying Training School, Wittering, 28.2.37. J. F. P. Brough, R. J. Cosgrove, C. L. Gilbert, D. C. F. Good, C. L. Hullock, D. Marshall, J. Paine, K. R. Rogers, D. F. B. Sheen, W. B. Wight, E. W. Yates, to No. 3 Flying Training School, Grantham, 6.3.37. H. H. Adams, A. S. Ainslie, to No. 210 (F.B.) Squadron, Pembroke Dock, 6.3.37.

Acting Pilot Officers.—G. H. B. Hutchinson, to No. 2 Flying Training School, Digby, 21.2.37. B. J. Rogers, to No. 63 (B) Squadron, Upwood, 15.2.37. S. C. Pendred, to No. 224 (G.R.) Squadron, Boscombe Down, 7.3.37. D. S. Richardson, G. P. Westropp-Bennett, to No. 11 (B) Squadron, Risalpur, India, 11.3.37. J. H. Giles, R. B. Smith, C. R. B. Wigfall, to No. 60 (B) Squadron, Kohat, India, 11.3.37. W. H. Martyn, to No. 11 Flying Training School, Wittering, 27.2.37.

Equipment Branch

Flight Lieutenants.—F. C. C. B. Hichens, to R.A.F. Station, Felixstowe, 12.3.37. J. S. French, to Headquarters, R.A.F., Aden, 11.3.37. G. L. Worthington, to No. 1 (Indian Wing) Station, Kohat, India, 11.3.37.

Flying Officer.—C. D. P. Franklin, to No. 28 (A.C.) Squadron, Ambala, India, 11.3.37.

Medical Branch

Group Captain.—A. E. Panter, to R.A.F. Station, Cranwell; for duty as Senior Medical Officer and Officer Commanding R.A.F. Hospital, Cranwell, 6.3.37.

Wing Commander.—V. R. Smith, to Headquarters, R.A.F., Mediterranean, Malta; for duty as Principal Medical Officer, 2.3.37.

Accountant Branch

Squadron Leaders.—K. R. Money, O.B.E., to R.A.F. Station, Halton, 4.1.37. W. E. V. Richards, to Aeroplane and Armament Experimental Establishment, Martlesham Heath; for Accountant duties, 11.3.37.

Commissioned Signals Officers

Flying Officer.—F. W. G. Aggett, to R.A.F. Station, Catterick, 8.3.37.

Dental Branch

Flight Lieutenants.—P. M. Margand, to R.A.F. Station, Gosport, 18.3.37. M. J. Pigott, to R.A.F. Depot, Uxbridge, 18.3.37.

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —

THE WEEK AT CROYDON

Lullingstone and All That : Special Occasion : The Control School : Strays

APPARENTLY the whole story of Lullingstone Aerodrome has been greatly exaggerated, and there seems to be no reason to suppose that Imperial Airways is committed finally and definitely to leave Croydon, nor is it anything but nonsense to say that Croydon is "condemned by experts" because it is within the fog area. The only "experts" who do not realise that, within the next five years, it won't matter twopence whether it is foggy or not, are self-appointed ones. It is not the question of fog but of future traffic congestion which matters. Even now commercial machines which, if alone in the skies, might reach Croydon with ease often have to wait outside the controlled zone for as long as an hour.

Croydon, I am assured on unimpeachable authority, will not be abandoned, and if Imperials move to Lullingstone, so much the better for them and for those who stay. As for rail transport facilities, I should like to know whether a midnight arrival at Lullingstone, containing three passengers, will be met by a special electric train. Moreover, machines with connections to make in half the cities of Europe are sometimes late. Will electric trains, like the much despised coach, stand by for an hour?

Tarmac Toppers

The importance of any visit by air may usually be gauged by the number and brilliance of the top hats on the tarmac, though some consideration should be given to who or what is under the ceremonial headgear. On Monday of last week no less a personage than Mr. Anthony Eden, together with the Swedish Minister in London, awaited the arrival of Mr. Sandler, Sweden's Foreign Minister, who arived by Scandinavian Air Express with Mrs. Sandler.

Mr. Mollison was at Croydon most of last week. His aeroplane, completely overhauled by Rollasons, had to be out of this country before Sunday in order to save a £2,000 import duty. When it would not start Customs very sportingly allowed him extra time.

M. Bouderie, of Air France, is now back at Croydon after his operation and a period of recuperation at Cannes. He looks fitter and says he feels a different man. Another old friend to return is Mr. S. L. Turner, who is flying again for Wrightways. He was one of the original "crack of dawn" brigade with that company, and won for himself an outstanding reputation for regular flying in exceptionally difficult conditions.

Practical Initiation

Mr. Jimmy Jeffs now has his school for (about a dozen) people wishful to undertake the arduous life of a control officer. Eminently sound and practical in all he does, Jeffs has not started a pedagogic academy where theory and blackboard stuff reign supreme, but has evolved an interesting and practical system. His classroom is to all intents and purposes a control tower, complete with radio. The actual course of machines, both British and foreign, is followed, and when pilots ask Croydon for any information the pupils have to make their own decisions—with speed. If a pupil decided on a course of action which would tie air traffic into knots, the reasons for its inadvisability are explained.

One of the things which are really needed at Croydon is a board at the entrance to the main hall on which business visitors may see the numbers and positions of the rooms occupied by the different firms. Upstairs one frequently meets forlorn strangers who have just completed their tenth circuit of the corridors (ducking to avoid stalactites) and who are worn out and almost in tears.

A. VIATOR.

"Quads." for T.W.A.

THE Boeing Company is to build a number of four-engined transports, based on the design of the "299" bomber, for Transcontinental and Western Air, Inc. With four G-100 Cyclones the machines will cruise at over 200 m.p.h. at high altitude.

Pan American Airways expects to order similar aircraft. Two of their machines will have sub-stratosphere equipment and should cruise on 75 per cent. power at 266 m.p.h. at an altitude of 20,000 ft.

The Cologne Disaster

A LITTLE before 12.30 a.m. on March 16 an Imperial Airways' D.H.86 crashed in a wood near Bergheim, some twenty miles from Cologne, with a loss of three lives. The machine had left Croydon at 9.30 p.m. on a schedule flight, but no mails or regular passengers were carried. All that is known is that the weather conditions over Belgium were bad at the time, with rain and sleet, and the last radio message was given at a little before 11 p.m. saying that the machine was flying in good visibility.

In addition to the crew, consisting of Capt. G. B. Holmes, the pilot, and Mr. C. E. Langman, the radio operator, Mr. C. F. Wolley-Dod, the European Manager of Imperial Airways, was on board.

Capt. Holmes flew with the R.F.C. in 1917, and remained in the Service until 1927. Thereafter he was a commercial pilot in Canada before joining Imperial Airways.

Mr. C. F. Wolley-Dod, O.B.E.

LAST week's Imperial Airways' tragedy not only lost Capt. G. B. Holmes and Mr. C. E. Langman to the company, but also resulted in the death of Mr. C. F. Wolley-Dod, the European manager for Imperial Airways. His colleagues are not alone in their grief for everybody at Croydon knew Wolley-Dod, and everybody both liked and admired him.

Educated at Rugby, Charles Francis Wolley-Dod served in the Sherwood Foresters until 1916, and from then onwards was a fighting pilot in the R.F.C. and R.A.F. until the end of hostilities. Amongst other jobs after the war, he was an instructor to the Spanish Air Force and was also with Vickers. Later he joined Instones, and finally became a pilot of Imperial Airways.

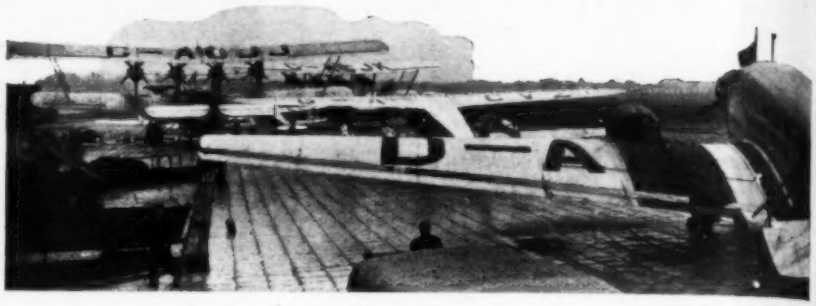
He was, however, one of those men with too great an organising and business ability to remain on the air routes for long. Imperial Airways wisely recognised this and made him manager of the Near East and North African Division. For the past five years Wolley-Dod had been European Manager, in which capacity his untiring energy and shrewd common sense, as well as his almost uncanny grasp of the whole European aviation situation, made him invaluable to his company and earned him the respect of all those, whatever their nationality, with whom he had business relations. His job was not an easy one, yet he seemed to perform it easily, and his success was best gauged by the exceptional measure of popularity he enjoyed. By his death air transport has lost one of its ablest men.

Commercial Aviation

AN AIRLINE PILOT THINKS ALOUD

Making the Sky Safe for Democracy

By CHARON



THE incredible apathy of the Air Ministry concerning civil air transport in this country is not only distressing but dangerous to an extent only appreciated by pilots of transport machines. The recently published Maybury Report was a step in the right direction, but there was nothing contained therein that had not been known for years by every internal airline pilot.

It seems to me that constructive criticism is badly needed. At the present moment one has only to undergo the alarming experience of flying in QBI conditions to realise what a nasty mess there is going to be at Manchester (or Liverpool), the centre of the Maybury plan, if things are allowed to remain as they are.

Before any new regulations concerning air line operation are put into force in this country it would be as well to obtain a consensus of opinion from the pilots who will have to obey them. At present too much is left to theory. The G.A.P.A.N. seems to be the obvious body to undertake the collection of this practical opinion, and a number of obvious problems would immediately present themselves for discussion.

Let me deal first with the problem of aerodrome design. Obviously it would be impossible to make every aerodrome in the country the same shape, but it *should* be feasible to limit the licensing of commercial aerodromes so that no transport machine would ever be faced with a take-off run of less than 800 yds. There are several aerodromes now being used for passenger traffic where neither take-offs nor landings are safe on the shorter runs unless a gale is blowing in the required direction.

Pilots are now expected to take-off in fog, but how many airports in this country have the necessary white line to assist them? From what height can dingy red obstruction flags be seen? How many pilots have the opportunity of practising with short-wave approach equipment?

Traffic Control

Then there is the business of traffic control. Last summer a pilot had the misfortune to approach one airport under QBI conditions with a load of passengers when six other machines had the same objective. Visibility was given as 500 yds. and sundown was due in ten minutes. Of the seven machines, three were under radio control, while the others lacked the necessary equipment, and their movements remained unknown until the last radio-controlled machine was about to land. Then they all appeared simultaneously. Morbid spectators lined the tarmac as five aeroplanes flew round in various directions, occasionally touching down and taking off again as the fence or buildings loomed up ahead. No one was hurt.

There was not the slightest excuse for the four pilots who, presumably without imagination, entered the controlled zone without wireless; the fog area was purely local. At all events the four culprits were not thrown into jail, either because control officers are not given enough authority or because this one was too kindhearted. Those same pilots are free to do exactly the same thing again, and not until a major collision takes place over an airport will anything be done.

The Air Ministry could learn a lot from the methods of Trinity House. There are few accidents on the Thames. Why must it be necessary for a lot of people to be killed in collisions before those in authority appreciate that a control officer has a tremendous responsibility and should at least be given the powers accorded to a policeman on point duty?

Again, there should be a qualified Met. Officer at every airport. Too often do pilots receive misleading (to use a very mild word) weather reports from the radio operator or traffic clerk at their destination. Not so long ago a machine left one aerodrome for another about 80 miles away, the clouds at which were described as having a base at 800 ft. On arrival, the pilot found that a height of 350 ft. was registered on his sensitive altimeter, which was proved to be correctly set. It transpired that the cloud-base had lowered during the flight, but no one had bothered to inform him. The control officer had made his guess at the weather that morning and it was cold out of doors. Once, too, an unauthorised person took it upon himself to issue a weather report. The pilot to whom he spoke took off in blind conditions, and subsequently killed himself and his passengers. An unqualified doctor's assistant would be flung into jail for making out a prescription on his own.

A solution to this sort of problem would be the provision of a Met. Officer, who would send weather reports to the control officer every hour and on every occasion on which the weather had deteriorated since the last report. The latter should be sent automatically to any machine on its way.

Radio Complications

Of all the aids to flying, wireless threatens to become the most complicated. So much so that even now the use of it frequently defeats its own object. It is high time that the whole situation was cleared up, and here it would do the Air Ministry no harm to enquire into the conditions prevailing in countries where civil aviation is more advanced. Their problems may not be the same as our own, but a compromise might be worked out to suit our own needs.

First of all let radio-telephony be scrapped. Its range is very limited and it is useless when in competition with W/T. Used only for the broadcasting of weather reports it would be very successful.

Two-way communication should be limited to normal traffic messages in which aircraft report height, position, course, speed, estimated time of arrival, and so on, with only such messages as would assist control officers in organising traffic. Every airport should be equipped with an automatic beacon transmitting a call sign at intervals, followed by a long dash. Every passenger-carrying aircraft should carry a radio operator and be equipped with the necessary homing device.

In this way each class of transmission could be allotted a separate waveband, and the ever-increasing menace of interference would be limited. There is no more unpleasant feeling in the world than that experienced during a take-off in fog while trusting to R/T and then to be left hanging in the sky receiving no attention because of interference.

There are a number of commercial airports at which private and school flying is allowed to take place in QBI conditions. The definition of QBI is clear enough, but too often one can see school machines circling an aerodrome in a cloudless sky but in visibility of less than a mile. The risk of collision in such hazy conditions, often aggravated by approaching sunset, is enormous. By all means let private flying continue under the most atrocious conditions, but it must be limited to places not used normally by passenger-carrying machines. Only last summer an airline machine had its aerial shorn off by a Puss Moth as it left the vicinity of its airport in hazy conditions. An infringement of flying regulations should be considered a crime punishable in the civil courts and should be reported by the control officer concerned.

Machines are far too often allowed to take off in bad weather conditions when it is known to the control officer that other machines are making for the aerodrome concerned. There is a definite time-lag between the last transmission of the approaching machine and the first transmission of another which is just taking off. The machine on the ground should not in this case be allowed to leave the tarmac until the other has landed.

More strict control over taxying aircraft is also required. A machine should not be allowed to leave the tarmac in bad visibility until the aerodrome is clear. One day this winter three machines full of passengers left the tarmac at a certain airport together, in visibility of less than 50 yards, making for the white line. The delay and confusion at the take-off point caused more waste of time than would have been the case had the pilots been compelled to leave the tarmac at intervals.

It has recently been suggested in a coroner's court that it should be the responsibility of the control officer to decide whether the weather is fit for a machine to take off. This would be carrying things much too far. However, unless discipline is introduced into civil aviation the time will come when unnecessary legislation on the part of laymen will force aerial transport to revert to kindergarten days. We have not the tradition nor the experience of the Mercantile Marine, but it would do us no harm to examine their system of communications and traffic control.

Airline operators in general form a class whose activities must be the most undisciplined in the world. How would you, who can manage a motor launch on the Thames, like to be put in charge of a tramp steamer between Liverpool and New York? A close parallel can be seen every day in civil aviation. Airline operators can, and do, employ pilots of 300 hours' experience to fly on routes in England which, from the point of view of weather and lack of facilities, are admitted to be among the most dangerous in the world. The minimum requirements for a transport pilot are such as to make engine drivers and truck drivers green with envy, and operators are not slow to take advantage of the situation. This applies more to unsubsidised concerns where economy is the be-all and end-all. Such short-sightedness cannot pay and it would be in their own interests were operators to insist on a subdivision of the present "B" licence. It is fortunate that the insurance fraternity are not blind to what is going on. They know more about individual pilots than the managing directors of the majority of operating companies.

Few complaints are heard to-day from pilots about overloading, but it still persists in one form or another. Perhaps the most common offence is to send out a machine which is not fully loaded but which has luggage in the cabin gangways because the accommodation in the hold is inadequate. Imagine the effects of a take-off crash followed by fire.

Sufficient importance is not attached to range for sea crossings. In this country, where wind and weather are so changeable, any machine on sea-going passenger service should carry enough fuel to reach its destination and to return to the nearest aerodrome with at least half an hour's fuel in hand. Operators will not fit extra tanks because the pilot will always ask for full tanks—and that means reduced payload.

Among private owners and hirers the Press stand out as being the most culpable operators in England. Time and again valuable lives are risked for the acquisition of some fatuous picture, which, as often as not, has to be taken from some single-engined machine carrying no radio and flying miles away from land.

The time has come when the Air Ministry should exercise closer control over operators, private or otherwise. There are flying regulations, and they should be enforced and supplemented as circumstances decree. Is it too early to make a plea for discipline in the air, or must we wait for some more crashes before something is done?

South American Subsidy

IT has long been known that tenders had been invited by the Air Ministry for the operation of a mail service to and from South America. The contract will, we learn, be placed during this week, and there does not appear to be much doubt that the company concerned will be British Airways, though the choice lies between this and three shipping concerns. It has repeatedly been suggested by *Flight* that experimental work over this route should be started with as little delay as possible, since both Air France and D.L.H. have now obtained a very firm footing.

Survey by Double-Eagle

A VERY special Double-Eagle is now in course of construction at the British Aircraft Mfg. Co.'s works at Hanworth. It is to be used for aerial survey work in South Africa, presumably by African Air Surveying Co. (Pty.), Ltd., and shows promise of being a most interestingly equipped aeroplane.

Two Series II Gipsy Sixes with v.p. airscrews are fitted, giving a normal cruising speed of 160 m.p.h. or more, and the control layout has been modified to take a Smith automatic pilot. This is particularly necessary in a machine which is to be used for survey work, since it must naturally be flown on very accurate courses. This Double-Eagle will be the first of a batch of six which British Aircraft are putting down and is, of course, a somewhat special affair as far as internal arrangements are concerned.

Electras in England

SINCE the standard Lockheed Electra was originally described in *Flight* in the latter part of 1935, any changes and developments have been mentioned from time to time as these appeared. It will not be necessary, therefore, to give a description of the first of the five Electras for British Airways which will shortly be in service.

However, the new fleet will be very completely equipped, and the machines have several features which are far from commonplace over here. Apart from constant-speed airscrews, these Electras have Goodrich de-icing equipment with Slinger rings, exhaust gas analysers (necessary in the case of c.s. airscrews in order that the mixture may not be accidentally made too lean), and very special radio equipment. The latter includes Marconi two-way and D/F equipment, and Lorenz blind-approach receivers, which, incidentally, will be the first of the new three-channel type to be fitted to any machine.

Swissair's Summer Plans

ON April 4 Imperial Airways will rejoin Swissair on the Basle-Zurich run from London, so there will be two departures daily in each direction. As in the case of their daily winter service, Swissair will operate on Sundays, whereas Imperials will only fly on week-days. The afternoon departure from Croydon will connect with the R.A.S. arrival from Belfast, Dublin and Liverpool. The new D.C.3. should shortly be in service.

On the same date Swissair will start Zurich-Paris and Zurich-Berlin runs, the latter in conjunction with D.L.H., while the Zurich-Vienna service will be opened on May 1 with the company's new Jumo-engined Ju.86.

North Atlantic: New Moves by P.A.A. . . .

A REPORT has been received in Copenhagen from Reykjavik stating that the Icelandic Government has granted a renewal of Pan American Airways' concession, which expired on January 1. The well-known Arctic explorer Vilhjalmur Stefanson has been very active on behalf of P.A.A., and secured a new concession for them on condition that an experimental service between Reykjavik and Copenhagen is started this summer; that regular fortnightly operation of this line shall be maintained throughout the summer of 1938; that experimental flights between Iceland and America are started in 1939 or 1940; and finally, that a regular transatlantic service is opened in 1942 at the latest. P.A.A. have consented to these demands.

The European representative of P.A.A., Capt. P. Botved, arrived in Copenhagen last week from the States. He confirmed the details of the Reykjavik-Copenhagen service, and added that American machines will probably be flown over via Greenland in the early summer.

About six million letters are being mailed every year from Scandinavia to the U.S.A. and Canada.

Meanwhile Norway is preparing to do her share in the transatlantic air services. The city of Bergen is expected to be a stopping place on the projected Pan-American service, via Greenland and Iceland. The new Newcastle-Stavanger service, which should open on May 1, will also make a stop in Norway.

Swedish A.B.A. are negotiating with Soviet Union authorities concerning a Stockholm-Leningrad line, which will be extended to either Stavanger or Bergen. A number of new coastal weather report radio transmitters are to be erected in Norway.

. . . and by D.L.H.

GERMANY'S contribution to Atlantic flying experiments was increased last week when D.L.H.'s fourth catapult supply ship, the *Friesenland*, was launched at Kiel. When this motor ship is complete she will be stationed near Horta, in the Azores, and the *Schwabenland* will be moved from the South Atlantic to New York. In this way catapult ships will be made available at each end of the really long-distance section of the southern North Atlantic route.

Commercial Aviation

CHAOS IN AUSTRALIA

The Change from Commonwealth to State Control : What it Means

By EDWARD J. HART (lately Editor of the Australian paper *Aircraft*)

BETWEEN sunrise and sunset of March 6, 1937, the whole aspect of civil aviation in Australia changed from national acceptance of the Air Navigation Act (1921) to what Australia's Prime Minister terms "absolute chaos"—and back has swung the pendulum to the disastrous pre-control era of 1918-20 when a pilot was free to break a neck without breaking an Act.

The confusion defies exaggeration. I am writing five days after the States (by a 4-2 majority) had rejected Commonwealth control of civil aviation in favour of control by each State. In London to-day no Anglo-Australian official can shed a ray of light on the situation. No word has been received from Australia by the High Commissioner, the air liaison officer at Australia House, the six Agents-General, or the Civil Aviation officer in charge of Empire air mail services. This applies also to the Air Ministry and managing director of Imperial Airways. All are still awaiting an official statement.

A Good Customer

While the cause of this upheaval is Australia's own affair, its effects may vitally concern our aircraft industry. For Australia has proved a good customer. Most of her airline contractors have always bought British. The twenty-nine services now operating over 16,776 miles and logging a yearly aggregate of 4,630,080 miles, offer a priceless tribute to British aircraft design and construction. Her flying clubs all use our equipment.

All these flying enterprises exist on subsidies granted by the Commonwealth Government, under a liberal policy sponsored by the late Col. Brinsmead, who became Controller of Civil Aviation on December 6, 1920.

By the recent referendum the federated States of Australia invalidated the Air Navigation Act which for sixteen years has governed all civil flying in Australia and New Guinea; simultaneously they declared unconstitutional a department which, till then, was the aviation nerve-centre of a country as large as Europe.

The cause of all this was a trivial incident. A private pilot had been prosecuted under the Act. Against the conviction his counsel submitted a novel plea—that the Act should never have been passed. He quoted the Constitution Act (1900) and argued that a prosecution under the 1921 Act must fail unless the six States, by referendum, empowered the Commonwealth Parliament to extend the scope of the 1900 Act by amending Section 51. The High Court upheld the appeal and quashed the conviction.

Early Years

A referendum was taken. Victoria and Queensland voted for the amendment; New South Wales, Western Australia, South Australia and Tasmania against.

Section 51 reads: "The Parliament shall, subject to this Constitution, have power to make laws for the peace, order and good government of the Commonwealth with respect to . . ." and goes on to enumerate thirty-nine separate matters. That these do not include aviation is but a natural omission, for the Act was passed on July 9, 1900, and the Wright Brothers first flew on December 17, 1903.

Time marched on. In pre-war Australia the men who hopped off the ground for a few minutes could be counted on the fingers of one hand. But as early as April, 1918, I was writing of the need for centralised control; I was, in fact, the first in Australia publicly to advocate it.

The Air Navigation Act was needed in Australia a year before it came into force in England. In 1918 two so-called commercial aviation companies were registered; one with nominal capital of £150,000. Twelve others were born in 1919, and fourteen more in 1920. Also there were several private owners—some wholly untrained. Most of these enterprises were short-lived—literally. For three years there was no semblance of official control.

Since 1920 the Commonwealth Civil Aviation Department has been sole controlling authority. Centralised in Melbourne, at Victoria Barracks, the organisation has been built up, step by step, with patience, tact, foresight and unremitting toil. Here are kept all records, files, maps, reports, C.A. forms, statistics, and an aviation library unique in Australia. In all-round efficiency the department has but little to learn from Gwydyr House.

The functions of the old C.A. Department will, I expect, be taken over and sextuplicated by six State departments, each with its own C.C.A. More than one political party is in power in the State Parliaments. Will they agree to a uniform aviation policy? I think not. Some of the States pride themselves on being "different." For years there has been talk of secession. Four out of five State-owned railway systems break gauge at the contiguous State's border.

The transfer of civil aviation to State control will be a slow and tedious affair. I doubt if the necessary legislation can be completed before 1938. First, there must be a Premiers' Conference. It cannot be held until the last Premier returns home from the Coronation festivities. Next, the Premiers will confer at Canberra, this time with the Commonwealth Cabinet. Thirdly, they will report back to their own Cabinets. Finally, there will be twelve separate meetings (of six Legislative Councils and six Legislative Assemblies) to debate and pass Bills and Acts to control civil aviation.

What of future subsidies? Who will pay them? And who will receive them? Will preference be given to native sons? Under Commonwealth administration the first air mail contract, in Western Australia, went to a Victorian (Norman Brearley); the second, in Queensland, to a Tasmanian (Hudson Fysh). Mosts air lines serve more than one State. Holyman's Airways serves three; Adelaide Airways four. These twenty-nine air line contracts are important. The longest is 4,36[illegible] miles; others are of 2,252, 1,453 and 1,164 miles. Eleven services carry mails under subsidy from the P.M.G.'s Department; fourteen others from the Commonwealth Defence Department. Will the State Governments renew their subsidies? Or will they raise the old bogy of competition with State-owned railways and subsidised shipping and surface transport?

Empire Services

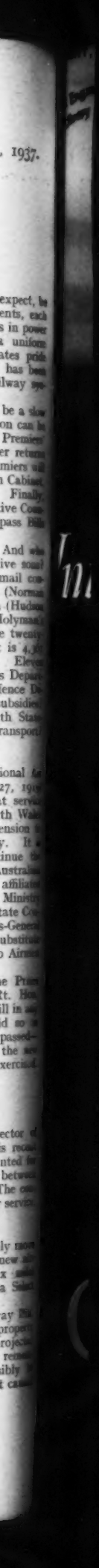
Unless Australia's authority to sign the International Air Convention (which she did at Paris on November 27, 1919) also proves unconstitutional, the Empire flying boat service to Brisbane should not be affected; but in New South Wales Mr. Lang's Labour Party may try to block its extension to Sydney by Qantas, which is a Queensland company. It is unlikely that individual States will refuse to continue the Commonwealth subsidy to sections of the Royal Australian Aero Club. These are strictly local organisations, affiliated through the Royal Aero Club to the F.A.I. Air Ministry liaison will probably be attempted between the six State Controllers of Civil Aviation and their respective Agents-General in London, assuming, of course, that they will not substitute something of their own for the Air Ministry Notices to Airmen and Ground Engineers.

Seventeen years ago the Permanent Head of the Prime Minister's Department, on instructions from the Rt. Hon. W. M. Hughes, wrote to me: "The Commonwealth will in any case itself centralise the control of flying." It did so on February 11, 1921, when the Air Navigation Act was passed—*but without a referendum*. There lies the root of the new problem. Control was assumed, centralised and exercised. Now there is none.

Batavia—Manila

IT appears that Mr. Plesman, the managing director of K.L.M., has succeeded in the major object of his recent visit to the United States. Permission has been granted for the operation, by K.N.I.L.M., of a weekly service between the Netherlands East Indies and the Philippines. The conditions involve the right for P.A.A. to operate a similar service.

A Customer from Lullingstone?

THE possibility that Imperial Airways may eventually move their European flying base from Croydon to the new airport which is being constructed at Lullingstone, six miles south of Dartford, was mentioned at the sitting of a Select Committee in the House of Commons last week.

The Committee was considering the Southern Railway Bill, in which powers are sought by the company to alter property in Buckingham Palace Road in connection with the projected headquarters for Imperial Airways. It should be remembered, however, that the new airport cannot possibly be ready for at least eighteen months, and any excitement caused by the suggestion is more than premature.